City, County and State

PUBLIC WORKS

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JANUARY, 1934

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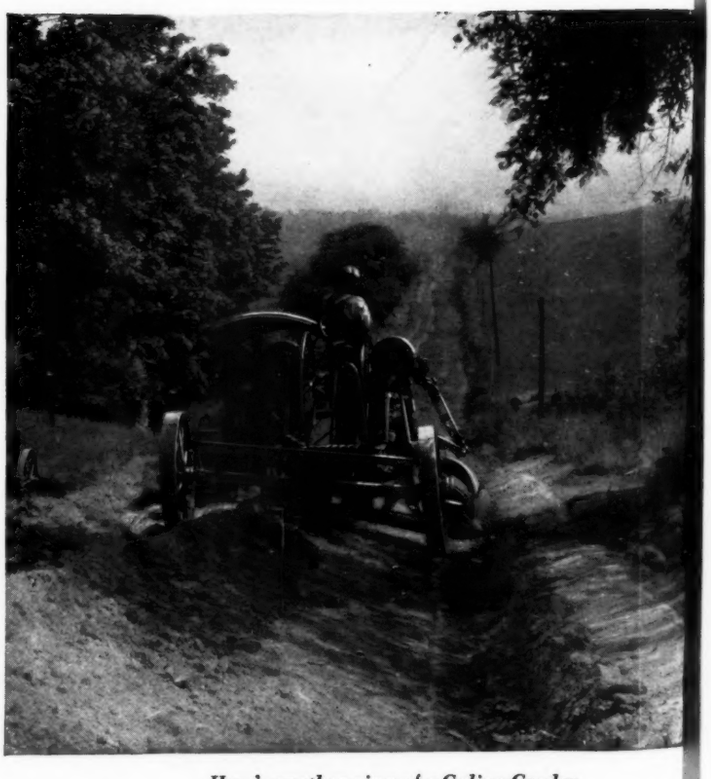

Here's another view of a Galion Grader really going places and doing things.

The Galion Iron Works & Mfg. Co.

GALION, OHIO

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JANUARY, 1934

January
1934

PUBLIC WORKS

Vol. 65
No. 1

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

TABLE OF CONTENTS FOR JANUARY, 1934

TIMEWASTERS

A little late, but a Happy New Year with lots of problems—tough ones—to you all. And here's thanking Don Hastings, who sent us a little holiday remembrance in the shape of a *Scorometer*, which tells you everything about contract bridge except which way to finesse. It's his own devising, and the experience he has had *Timewasting* shows in the clever way the device is figured out.

We feel economical after receiving our Christmas Bills and so offer our readers only one problem this month. It is a long one and solutions also take up considerable space, so one is the limit for January. Fittingly enough, it is called:

Begging the Question:

Five beggars meet at the end of the day and find that each has in his bag the same number of coins. One of them suggests the following game. He places the five beggars at the points of a pentagon, with himself at 1 and the others numbered clockwise, 2, 3, 4 and 5.

The originator of the game, No. 1, tosses his bag to No. 3, his next neighbor but one at his left, who takes from it two coins which he gives to Beggar No. 2 and four coins which he gives to Beggar No. 4, and then adds from his own bag half as many coins as were originally in the bag when he received it. He then tosses the bag to No. 5 who takes out one coin for No. 1 and four coins for No. 4, and in turn adds half as many coins as were in the bag when he received it. He then tosses the bag to No. 2, who takes from it and gives 1 coin to No. 1 and three coins to No. 3, adds half as many as were in the bag when he received it, and tosses the bag to No. 4. This beggar passes 3 coins from the bag to No. 3 and 5 coins to No. 5, before adding half as many coins as were in it when he received it. He then tosses the bag to No. 1, who adds the 2 coins given him by Nos. 5 and 2.

No. 1 is now happy to note that he has all the coins which originally belonged to all the beggars. How many has he?

Solutions:

Lots of answers to the problem regarding the squares, but none of them (so says APF) is correct. An interesting method of solving this type of problem which is new to us, was sent in by S. Cameron Corson.

Mr. Eisner's problem about the three numbers had an unusual catch in it. According to our own experience and that of several solvers, one of the three numbers must be negative. Granted this, there are a large number of solutions—an infinite number we believe. R. N. Clark, in a long solution, gives the following general solution:

$$x = n(-a)\quad y = n(a+1)\quad z = n(a^2+a)$$

The other problem we have not had time to work out. Though it does not look particularly difficult, no answers that we believe to be correct have been received. Our little group of serious thinkers must have been pretty busy on other things over the holidays.

W. A. H.

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A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

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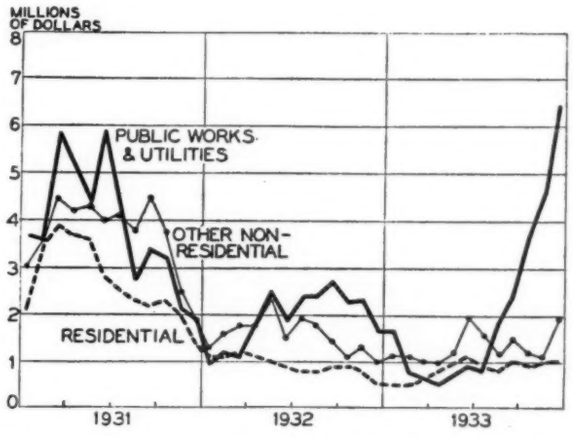
Vol. 65 — *January, 1934* — No. 1

More Money Expected for PWA and CWA

AS THIS is being written, Congress is in session and what will be done, or not done, in connection with PWA and CWA funds can not be foretold. However, it is just about absolutely certain that there will be more money for both, and that both will be continued upon substantially the same terms as at present.

Estimates of the amount of funds which will be set aside for continuation of the PWA vary quite materially, and the total will doubtless be dependent upon the policy that Congress adopts regarding appropriations for Federal projects. That is, instead of having Federal projects financed through the PWA, specific allotments may be made by Congress for these, leaving to the PWA the matter of handling non-Federal construction.



Average Daily Value of Building Contracts Awarded by Major Type (F. W. Dodge Corporation data for 37 States —latest figures are averages for first half of December.)

"All of these increases are contrary to the usual seasonal tendency at this time of year. . . . The principal factor was a further increase in the placing of public works contracts under the program of the Public Works Administration." *Monthly Review of the Federal Reserve Bank, New York.*

An average of the estimates of several well-informed officials in Washington of what is likely to be granted to PWA is around two and a half billions; it may be more; it may be less. It is likely that essentially the same terms of grant, loan and repayment will be continued, since it is felt that any variation in these tending to make them more favorable, should be retroactive. Thus, any city, county, state or district need not hesitate to go ahead right now with their application for funds, since there is little doubt that more money will be available, and on the same terms for grant or loan and repayment as before, or possibly on easier ones.

Few officials are willing to hazard an opinion regarding what is likely to be done for highway construction and maintenance, but there is little doubt but that this will be well provided for along lines to be suggested by Thos. H. MacDonald, chief of the Bureau of Public Roads.

Because it is recognized that the peak of employment through construction due to the PWA will not be reached by Feb. 15, it is exceedingly likely that the CWA will be continued on essentially the same terms for some two or three months thereafter, until practically all CWA labor has been absorbed by the PWA work. This will permit labor to be employed throughout the entire winter.

There is a general feeling that the public works program is the best way yet found to distribute money and increase the purchasing power of the public, while providing needed and worthwhile projects for our communities. Several important and interesting facts stand out in this regard:

1. The close check maintained on the projects submitted has insured that only needed and worthwhile projects are approved. This has caused some delay with the consequent protest, but the delay has been due to the determination that only sound projects shall qualify.

2. There has been no report of graft or dishonesty in connection with PWA funds or PWA work. It is possible that some money has been spent by some communities for engineering or legal assistance which was not necessary for obtaining these funds, but this can scarcely be classed as dishonest.

3. The geographical distribution of the work has affected all parts of the country favorably. Even the more conservative business reviews now cite PWA construction as an important factor in the business pickup. To what extent the money released through the CWA and the PWA affected the unexpectedly large holiday volume of trade is uncertain, but it doubtless was an important factor.

4. It is generally admitted that the amount provided for public works construction has been insufficient to cover the justifiable demands for the money, and there doubtless will be calls for as much more as Congress sets aside, even up to three billions or more. In this connection, it is interesting to note that so far only about 35% of the total public works fund, or a little more than one billion dollars, has gone into public works construction projects, the remainder (excepting about 12% unallotted) having been used for other types of work.

The information in this article is based on impressions gained from interviews and contacts in Washington during the first week of January. In general, there does not appear to be any question regarding the continuation of the PWA and CWA; the only question seems to be how much.

Bituminous macadam road in May, 1912, soon after completion

Same road after twenty-one years of service

How effective maintenance has preserved a Chevy Chase road

Highway Maintenance and Betterment in 1934

By Thos. H. MacDonald

Chief, U. S. Bureau of Public Roads

THE safe, economical and comfortable use of most of the highways in the United States is dependent almost entirely upon day-to-day maintenance operations. This maintenance work, in the case of the States and many counties, is highly organized and under efficient technical supervision and control. Our whole improved road mileage absolutely depends upon such maintenance for its existence.

At this time, especially, when the most energetic effort is being put forth to put unemployed men to work, the necessary and useful work of highway maintenance and betterment must commend itself as an activity of the highest value.

That the opportunity of employment afforded by maintenance work has not been overlooked during the past year or two of deepest depression is indicated by statistics of numbers of men thus employed, compiled by the Bureau of Public Roads and shown in the follow table.

STATE AND FEDERAL EMPLOYMENT ON MAINTENANCE

Compiled by United States Department of Agriculture Bureau of Public Roads

Month	1933	1932	1931
December		139,986	134,437
November		160,728	123,652
October	171,302	158,819	124,483
September	160,560	155,128	117,113
August	158,237	151,202	117,359
July	141,644	130,118	108,003
June	152,941	129,019	107,692
May	142,767	129,773	94,452
April	137,066	141,582	93,732
March	145,618	132,842	91,334
February	140,689	137,938	80,186
January	151,039	141,081	54,299

It is apparent that maintenance activity has been employed, especially during the winter months when other highway work is at low ebb, to occupy each year since 1931 an increasing number of men. Nearly 100,000 more men were thus employed in January 1933 than in the same mid-winter month of 1931. In October last more than 171,000 men were employed, over 13,000 more than in October 1932 and nearly 47,000 more than in the same month of 1931.

The figures also show that the number of men this year employed on maintenance work has been kept much more nearly constant than in 1931. Between the minimum of 137,000 employed in April and the October maximum of 171,000 there was a range of less than 35,000, as compared with the difference of 80,000 men between the smallest and greatest monthly employment in 1931.

Looking to the coming year's work with a view to continuing the activities of the highway departments as well-organized and smoothly-functioning agencies of public works in the relief of unemployment, the necessity of continuing the services of the widespread State maintenance organizations is apparent. The maintenance supervisors of the various State highway departments are in intimate contact with the work that must be done on the State highways, and the needs of the counties can be determined quickly by these supervisors through county officials. The State highway departments are closely knit agencies of Government, controlling disciplined organizations sufficiently widely dispersed to insure reasonable success in any emergency effort to provide work for many of the unemployed men throughout the country. Such work can be undertaken by these maintenance organizations with reasonable assurance that considerable highway value will be created by the work done.

The idea formerly rather prevalent that roads once built could be expected to continue in service indefinitely without further attention is being replaced by the understanding that all roads, regardless of type, require intelligent care to repair, as it occurs, the wear that must be expected on roads that are used as heavily as most modern roads are. Yet, even now, it is probably true that the general public has little conception of the relatively fragile character, from the standpoint of time-durability, of perhaps 75 percent of our surfaced mileage of highways.

The latter comment is not, in any sense, a reflection on the quality of road construction. The relatively fragile surfaces referred to represent no failure of the road builder but, on the contrary, his deliberate choice as the means of providing as quickly as possible the low-cost, dustless and mudless surfaces that are needed, if the traffic is to be properly served, on tens of thousands

of miles, and on which any improvement would be long deferred if it were necessary to await the building of more durable surfaces.

Not only are these low-cost surfaces built with the full expectation that a continuous protective and preservative treatment will be given them; but it is actually expected through such treatment gradually to improve the original construction. In this type of work, maintenance, in the strict sense of the word, shades almost imperceptibly into betterment.

Resurfacing and other betterments may add many years of life to a road

The accomplishment of public works of lasting value using the labor of men who otherwise would be unemployed is the avowed purpose of the Public Works Administration and also of the Civil Works Administration which was created to hasten employment with the aid of public works funds. Betterment of highways most certainly is a work of lasting value and both of these agencies have appropriated funds for such work.

While the appropriation of $400,000,000 made specifically for highways by the National Industrial Recovery Act is to be used for construction only—the States and local Governments being expected to maintain the roads built—there will be included a large amount of work that would properly be classifiable as betterment, and betterment of an exceedingly valuable type. Emphasis is placed on the elimination of traffic hazards through betterments such as the separation of grades at railroad crossings, widening narrow roads, replacing weak bridges, road relocation to avoid dangerous crossings, and construction to facilitate traffic flow.

An interesting betterment that has advantages from both utilitarian and aesthetic standpoints is the flattening of highway excavation and embankment slopes and covering them with rich soil that will grow grass readily. Such work employs a maximum of hand labor, reduces regular maintenance costs by lessening the effects of erosion, decreases traffic hazards through improved visibility on curves, and enhances materially the beauty of the roadsides. Other important betterments, in addition to the repair of road surfaces, include laying tile drains and cobble gutters, fencing right of way, building guard walls, lengthening and improving waterway structures, straightening stream channels, and many similar minor operations.

The removal of snow continues as a necessary winter highway work that has been carried on for a number of years to keep traffic moving and, at the same time, to relieve some unemployment at a season when distress generally is widespread. Such work, although in the nature of an operating charge, is performed by the regular maintenance forces augmented by unemployed men as conditions may require.

Footpaths and sidewalks constructed where needed along roadsides in congested areas furnish a new and important means of employing a large number of men on hand labor work. The value of such footpaths and sidewalks as a protection to pedestrians has been recognized for a long time and their construction is a much needed highway betterment.

The high value of betterments to the public that travels the highways plainly appears when the addition to the serviceableness of the roads is considered. Such work also constitutes an investment that reduces materially the recurring annual cost of regular maintenance as well as adds to the utility, safety and convenience of the highways.

Bringing highways up to date is a matter of great importance to the traveling public. Existing roads were built in sections at various times and during various stages in the development of the science of road building. Under similar traffic conditions, it seems reasonable that the various parts of a highway should show similarity of improvement. The need for modernization of highways to meet changing conditions of vehicle speeds and weights is self-evident to any traveler on the roads.

During 1934 regular maintenance and betterment of highways must continue, with added emphasis on betterments, following in natural sequence the initial highway construction. In the present unemployment emergency, highway betterment furnishes a natural and widely-diffused means of employing many men. Machine operation also is required in maintenance and betterment work, although to a less extent than in highway construction activities.

Asphalt respairs, cold patching of gutters and new binder courses give employment to many men

Metering Water Would Save Philadelphia $180,000 a Year

THE Bureau of Municipal Research of Philadelphia in December, 1933, made public a report on water consumption and metering which was the result of investigation and study of the records of the water bureau and especially of the department of the receiver of taxes (where the meter readings are kept) which were continued actively for about two years following May, 1927, and intermittently thereafter.

The Bureau's findings on consumption and its estimate of the effect of universal metering on the city's requirements for water are given in detail in this report, but may be briefly summarized as follows:

1. The total output of the Philadelphia water works in 1927 was 125,983,400,000 gallons; in 1932 it was 111,337,500,000 gallons, a decrease of 14,645,900,000 gallons, or over 11%
2. The quantity of water taken through meters in 1927 was 45,946,700,000 gallons, leaving 80,036,700,000 gallons to be accounted for in other ways.
3. Of the 80 billion gallons (approximate), about 19 billion gallons may be accounted for as water used for municipal purposes, that is, for street cleaning, fire-fighting, public swimming pools, public schools, city hospitals, and other municipal activities.
4. About 16 billion gallons may be accounted for as water lost in the distribution system, through leaks and breakages of the water mains.
5. There remain then 45 billion gallons as the quantity of water taken in 1927 through unmetered private services.
6. From the Bureau's analysis it would appear that only 27 billion gallons would have been taken through the unmetered private services had they been metered, a saving of 18 billion gallons.
7. Because there were fewer unmetered private services to take water in 1932 than in 1927, metering of the unmetered private services would have saved less water in 1932. The estimated saving is about 17 billion gallons.
8. In 1927, complete metering would have reduced the per capita water consumption in Philadelphia from 180 gallons a day to 155 gallons a day, a reduction of about 14%. In 1932 it would have reduced the per capita consumption from 154 gallons a day to 131 gallons a day, a reduction of 15%.
9. The saving in water that would result from complete metering would make possible a saving in operation and maintenance expenses of the water works of about $180,000 a year.
10. Savings would arise also from the fact that less plant capacity for pumping and treatment would be needed.
11. Smaller demands would be made on sources of water supply.

There were 124,895 domestic meters, 15,021 industrial and 1,572 institutional in service in 1927, and the records of these were used in the study. A leakage survey was being made in 1927, and in connection with this the 470 meters 4 inches and over were found to under-register an average of 13%. Records of several other large cities were obtained and their figures for under-registration and for total consumption per service seemed to indicate that an assumption of 13% for Philadelphia was reasonable.

All Philadelphia consumption is pumped and the total is measured. This total, less the metered consumption corrected for under registration, left the unmetered private consumption plus municipal use, plus loss in the distribution system.

In estimating the public consumption, consideration was given to figures reported for Chicago—5 to 6%; Detroit—11%; New Orleans—26%; and Turneaure and Russell's estimate of 10% as an average for American cities. New Orleans' figure included 19% for street sprinkling and flushing, which was thought to be considerably more than is used in Philadelphia. On the other hand, few of the public uses were metered in Philadelphia and therefore were probably higher than the metered ones in Detroit, and 15% was considered a reasonable assumption for Philadelphia.

Philadelphia's leakage survey of 1927-1932 located underground leakage of 12.4 billion gallons a year, which was presumably stopped, but undoubtedly there was much general leakage that was not stopped. Detroit found 5% of its pumpage, or a little over 3,000 gallons per mile of pipe per day, leaking under ground. Probably Philadelphia's is more, for construction of its system began over 130 years ago and some parts of it are very old; and the hammering of present-day traffic could not have been foreseen and provided against in the construction. Chicago had found a leakage of 16,804 gallons per mile of pipe per day in one test and 36,960 in another, or 13.5% of the pumpage. Considering these and other conditions and figures, the Bureau considered 13% as a reasonable estimate of underground loss in 1927 before underground leakage was located and stopped.

An estimate of what the consumption of unmetered services would have been if metered was made by assuming that the average would have been the same as the average of the actual consumption of metered services of the same class.

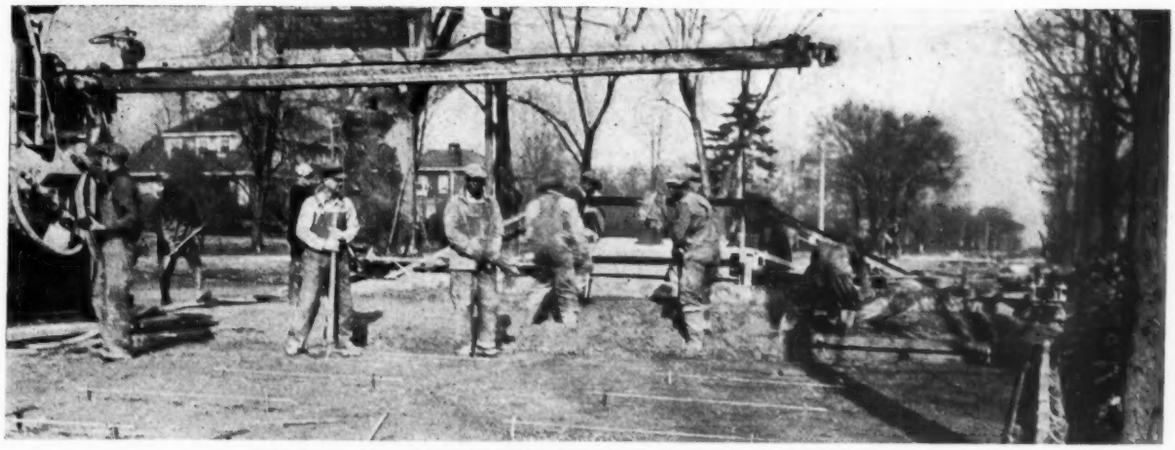
While there would be a saving in pumping, treatment and wear, there would be twice as many meters to be read and this additional cost is estimated to be $160,000 a year. There are no charges for installing meters, as the property owners pay these. The cost of operation of the water works in 1932 was about $19 a million gallons, and there was an estimated saving by metering of 18 billion gallons a year, giving a saving of $342,000, less the $160,000 added for meter reading, or a net saving of $182,000.

Since 1927 there has been a decrease of about 5½% in unmetered services and 11.6% in total output. Analyzing the various changes, the Bureau estimated an increase of 1 billion gallons in municipal use, and a decrease of 4 billion in metered consumption and 8 billion in distribution losses, which, calculating as for 1927, gave 41 billion gallons unmetered consumption in 1932, which would, if metered, be reduced to 24 billion, or a reduction of 17 billion gallons, and a net saving of $173,000.

Costs of Road Maintenance Work

The following data on maintenance costs from Feb. 21 to Oct. 15, 1933, using a FWD maintainer, have been reported by Ed. F. Monahan, Surveyor of Jackson Co., Ohio:

Mileage covered from Feb. 21st. to Oct. 15th	13,233
Average maintenance, miles per day	46.68
Average completed maintenance, miles per day	15.56
Cost per day of maintainer (including 20% depreciation)	$13.47
Miles per gallon of gas	2.3
Cost of blades per day (1147 miles for 24 days)	.23
Cost per mile of finished road	.865



One hundred percent relief labor on State Highway No. 43.

Winter Construction of Pavements in the State of Ohio

By Elmer Hilty
Chief Engineer of Construction, Department of Highways, State of Ohio

EXPERIMENTS made by the Ohio Department of Highways during the winter of 1932-'33 proved that concrete pavements could be constructed safely and economically in cold weather, and as a result of this experience several sections of pavement have been let by contract for construction during the winter of 1933-'34.

During the late months of 1933, regular methods of construction were followed in most cases, made possible by the then-prevailing mild weather. With the advent of cold weather, many of these jobs were continued, but winter methods are being employed and in some cases high-early-strength concrete is being used. In this manner this Department is providing employment for hundreds of men who would otherwise be dependent upon local charity.

Before embarking on the broad program of winter construction, now under way, the Department sought information upon methods and materials. To develop these facts, a paving project in Hamilton County was designated for work through the winter of 1932-'33. By this job, information was developed on such subjects as defrosting the subgrade, methods of heating water and aggregates so that concrete temperatures when deposited would vary between 65 and 80°, the use of high-early-strength concrete, kinds and methods for covering placed on concrete to avoid heat loss, and the continuity with which a winter paving project may be expected to operate.

Several methods for conditioning the subgrade were used. After fine grading had been finished, a heavy layer of straw was placed on the subgrade, and the next morning this straw was saturated with gasoline and burned. The use of a layer of sand one inch thick, in addition to the straw covering, was investigated. Patches of frost found by means of careful examination were removed or thawed out by means of a surface heater or flame torch. This latter device was also used to heat the forms and the reinforcing steel. Before concrete was placed, the subgrade was sprinkled with hot water. Considerable emphasis was placed on raising the temperature of the subgrade so as to prevent heat loss by the concrete, which in turn would delay the hardening action.

Steam coils and jets were placed in the aggregate bins by means of which the material could be heated to any desired temperature. The temperature actually used was determined by the length of haul, the prevailing air temperature and the desired concrete temperature when placed. Heated mixing water was obtained from a low-pressure boiler mounted on skids and drawn by the mixer as it advanced along the grade. Like the aggregates, the temperature of the mixing water was controlled to meet existing conditions. It was found that the boiler could not be connected to the original water tank on the mixer because of the destructive effect of steam pressure on the leather valves. To avoid this, an extra tank was used, from which extra tank the heated water passed to the regular mixer tank and thence into the drum of the mixer. This boiler was fired by the finishing machine operator during the periods when his machine was not working.

The Department specifications for high-early-strength concrete permit the use of either a high-early-strength cement or a rich mixture of ordinary portland cement, together with a three-minute mixing time. We have found it advisable on various projects to use high-early-strength concrete for winter work, due to the shortened curing period necessary and the minimization of hazard.

Relief labor laying high early strength concrete in Hamilton county.

Paving concrete was placed in the forms at a temperature varying between 65 and 85°, and spread and spaded in the usual manner, after which it was finished and straight-edged. When finishing had been completed, two thicknesses of damp burlap were placed over the concrete, followed by 12 inches of loose straw. It was found that concrete made with high-early-strength cement generated sufficient heat so that with the aid of the straw covering normal temperatures were maintained, aiding in the development of high strengths at early periods. This was beneficial, since it permitted the termination of curing operations after 48 hours and enabled the pavement to be placed in service when the concrete was two to three days old.

There was never any fear in our minds that the concrete would freeze. The 24-hour and subsequent cylinder tests, together with results of pre-molded beams and on cores cut from the pavement, had shown concrete compressive strengths which were entirely satisfactory.

By means of this procedure we were able to provide employment for men in winter months on work which had previously been active only during the summer season. Also bad detours were eliminated, as well as traffic hazards to the public because the early strength obtained from the concrete permitted its use by traffic within periods ranging from 36 hours to 3 days after placing. Abutting property owners along projects were very much pleased, in most instances, to have this work done in the winter months, since at this season windows and doors were closed and dust and dirt did not enter their homes as would have been the case during warmer weather.

There are several types of pavement which, according to our specifications, lend themselves to winter construction. We are at this time (December, 1933) placing several bituminous pavements and several brick surface pavements in addition to a number of concrete paving projects. The only extra cost that winter concrete paving construction might entail is that resulting from the use of high-early-strength cement or additional quantities of cement and longer mixing time. Other added costs are generally offset by the shortened curing period, together with other items which in summer months would have been higher in cost. However, while the high-early-strength concrete costs a little more, we believe that the public receives the full benefit of this small increase in cost.

Winter construction of concrete pavements gives work to men at a time when they need it the most and at a price which does not greatly exceed normal construction costs. It is also better, we feel, to provide as many unemployed as possible with the opportunity to support themselves through work rather than making it necessary to look to the community for support.

Relief labor on Ohio State Highway No. 43.

Milk Wastes in Sewage Plants

In New York State, and probably in many others, milk wastes cause most of the problems which industrial wastes produce in the operation of sewage treatment plants.

"The effect of such wastes, particularly those containing skim milk or whey, have necessitated their elimination from the sanitary sewer system," said Charles C. Agar, assistant sanitary engineer of the State Dept. of Health. "Odors, overloaded tanks, clogged filters and foul conditions in the effluent water course have developed where mixed milk wastes have been discharged in quantity into the sewer system. Under ordinary conditions, that is, where the industry is not disproportionately large in relation to the village population, wash and rinse water may be admitted to the system without serious effect on the plant. It is difficult, however, to control the type of material discharged into a handy sewer, so we attempt to discourage the practice as much as possible and encourage separate treatment or disposal of all milk wastes."

Notes on Sewage and Waste Treatment

Hydrated Lime in Imhoff Tank Operation

Hydrated lime is used successfully in several ways in the operation of Imhoff tanks in New York State, according to Charles C. Agar, assistant sanitary engineer of the State Department of Health. In a paper before the Seventh Annual Conference of the Pennsylvania Sewage Works Ass'n. he said:

"Experience has shown that hydrated lime added at daily intervals to the gas vents of the tank will aid materially in correcting a foaming condition and also provide many other desirable control features. When added at a rate of about 10 pounds per 1,000 population per day, foaming difficulties have disappeared within a few days to a week or two and scum reduction, odor control and pH improvement of the sludge have also resulted. Addition in solution form has been tried at a number of plants, but this method is cumbersome and difficult to carry out. The general practice is to sprinkle the lime over the scum in the gas vents, allow it to become moistened and dissolved somewhat in the scum layer, and then thoroughly break up the scum, which should not be over 12 to 18 inches in depth. If thicker than this it is removed before starting the treatment."

"Scum on the sedimentation compartment is usually removed daily and placed in the gas vents of the tank. At East Syracuse, where unusual conditions exist during the summer season, the scum formation has been difficult to control and no ordinary skimming device would remove the finely divided, greasy material. A small amount of hydrated lime sprinkled over the scum effectively controlled the odors from the material and tendered to coagulate the scum so that it could be removed with the skimming device."

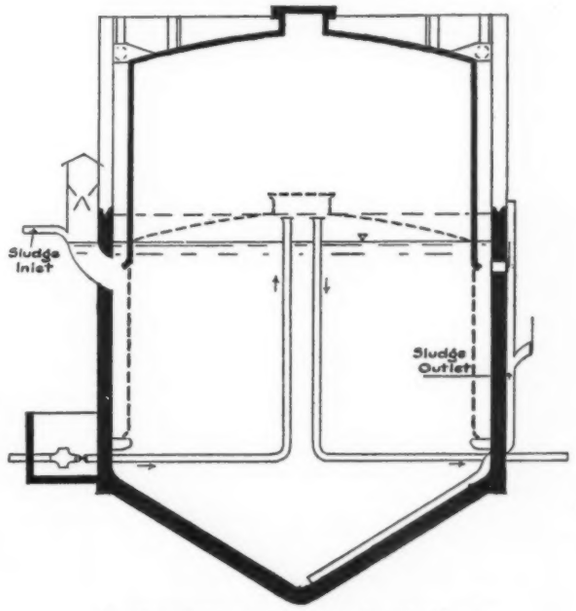
Purifying Beet Sugar Wastes

Three important reports on the purification of beet sugar wastes, one based on British experiences and two on American, were abstracted in a late issue of "Sewage Works Journal." Introductory to these, H. W. Streeter stated among other things, that "In the British report by Messrs. Richards and Cutler, . . . detailed results are given of an exhaustive series of chemical and biological studies embracing a period of three years, looking toward the establishment of the most effective and economical methods for disposing of beet sugar wastes without injury to streams." The quantity of beet sugar manufactured in that country increased from 7,000 tons in 1922-23 to nearly 300,000 tons in 1929-30.

Concerning the American reports of Eldridge & Theroux and of Max Levine he said: "The reader is impressed by the essential similarity of the general problems presented by beet sugar wastes in the two countries and by the striking agreement shown in the universal conclusion reached from these three investigations, particularly as regards the efficacy of biological treatment on trickling or percolating filters in dealing with the more highly organic 'process' wastes from the industry. The only noteworthy points of divergence in these conclusions appear to have been: (1) with respect to the treatment of these wastes by activated-sludge process, which yielded satisfactory results in the British tests, but was not found entirely successful in the Michigan studies, owing to excessive foaming during aeration, and (2) with respect to the re-use or recirculation of certain wastes in the beet sugar factories, which is regarded highly by the British observers as a supplementary measure, but unfavorably by the Michigan workers, on the ground that undue concentration of these wastes may result from such a practice. The advantages of controlled treatment of 'process' wastes from beet sugar manufacture in conjunction with municipal sewage are stressed by Messrs. Eldridge and Theroux and those of ponding by Dr. Levine. Neither of these two measures appears to have been considered seriously by the other workers, though local conditions doubtless may have their part in these divergences of viewpoint."

Combined Digestion Tank and Gasholder

Floating tops of digestion tanks were (according to Franz Fries, chief engineer of the Ruhrverband, Essen) first adopted as a practical proposition at Birmingham, England, where Whitehead used concrete floating gas collectors, and sheet iron ones were used by Kessener in Dutch plants. Mr. Fries has gone further and made the whole floating collector a gas reservoir, similar to the familiar gas tank with the sludge acting as the sealing liquid. The accompanying illustration (from an abstract of Fries' article in "The Surveyor") shows the general construction. The small pipes at the bottom are, one for withdrawing the gas, the other for admitting gas from the city supply in case of a shortage of sludge gas. In the latter case the two gases will mix and the coal gas be enriched.



Combined digestion tank and gasholder.

Chemical Precipitation at Freeport, Long Island

Abstract of paper before the New York State Sewage Works Association

By Lawrence L. Luther
Manager, Dept. of Sanitation, Freeport

FREEPORT, Long Island, N. Y., is a residential community of approximately 20,000 located on the south shore of Long Island. Its sewage treatment works (described by Mr. Luther in PUBLIC WORKS for May, 1931) consists of sedimentation tanks, separate sludge digestion in a stage digestion series, covered sludge drying beds, and effluent chlorination. A pumping plant with a capacity of 4.5 m.g.d. pumps the sewage 4,000 ft. to the treatment works. At present the average daily sewage flow is about 1,000,000 gals., but when all districts are completely sewered the works will probably be overloaded.

During the past year experiments were initiated in chemical treatment with the object of developing a method of improving the efficiency of the works and extending its useful life at the lowest possible cost. These have been made carefully and thoroughly and conclusions reached are based solely on results of actual experiments. They have been made with the cooperation of Weston Gavett and Abraham Slavin, of the office of Clyde Potts, and Herbert M. Wood of the office of Baldwin & Cornelius, village engineers; and R. N. Clark of the Innis Speiden Co., Allen Johnstone of the Wallace & Tiernan Co., Mr. Rankin of the Dorr Co., and Lynn Enslow, research chemist of Chemical Foundation were interested and helpful.

A small appropriation was made for an experimental plant, which was constructed by the sewer department employees. It included equipment for applying chemical, housed in a temporary building. Two "V" notch weirs were installed in the effluent channel so that each of the two sedimentation tanks received the same amount of sewage, permitting accurate comparison of treated and untreated sewage. Unfortunately the funds were not available for installing suitable means for mixing chemical and sewage, but by checking bottle tests with plant tests it was possible to correlate laboratory tests with plant operation.

Results of Experiments

The following is a brief resume of some of our findings:

1. A great improvement in the quality of the effluent may be effected by chemical treatment.

2. Chemicals, by accelerating the speed of settlement of the solids, have the effect of increasing the effective settling capacity of the sedimentation tanks.

3. The degree of purification effected by chemicals may be varied between wide limits. In accordance with the amount of chemical used, the clarification may be varied from a barely perceptible improvement to the production of a water-clear effluent.

4. Ferric chloride was found effective as a coagulant. The efficiency of ferric chloride was increased by proper mixing; in fact, mixing was found to be essential when ferric chloride was used alone.

5. Ferric chloride used with chlorine gave better results without mixing than ferric chloride used alone without mixing. The efficiency of ferric chloride and chlorine is apparently improved by mixing.

6. Prechlorination was found to require no more chlorine than with post-chlorination.

7. Improvement in condition of tanks was noted when chemical treatment and prechlorination was used. Floating solids were less and tanks were cleaner.

8. Mixing was found of great importance.

a) High speed mix for a short period was of some benefit.

b) Slow mixing was found of greatest benefit.

c) When slow mixing was used there seemed little advantage in an initial rapid mix.

d) Considerable increase of settling efficiency resulted from slow mixing with no chemicals added.

e) Mixing is of greatest aid with low doses of chemical. With large doses, less mixing is required.

f) The optimum time of mixing appears to be 15 minutes; a slight improvement followed longer mixing.

9. Ferric chloride accelerated dewatering of fresh and digested sludge.

10. The re-use of previously coagulated solids appeared to have some merit.

11. It was found that with the present Freeport sludge, 1 lb. per million of applied ferric chloride could remove approximately 0.4 ppm of turbidity.

12. With proper mixing, the application of chemicals was not as critical as had been expected. The dosage was varied between considerable limits and good results obtained. The addition of more than the necessary quantity is, of course, wasteful. Should the action of the chemicals have been found critical (that is, a particular sewage strength requiring an exact quantity of chemical), practical operation would be most difficult and constant watching and adjustment of chemical dose would be necessary.

13. The cost of chemical treatment varies with the degree of treatment. This is an advantage. A jump from primary to secondary treatment requires a large immediate increase in capital and operating costs. With chemical treatment as an intermediate process, the increase and expense is in proportion to improvement and efficiency.

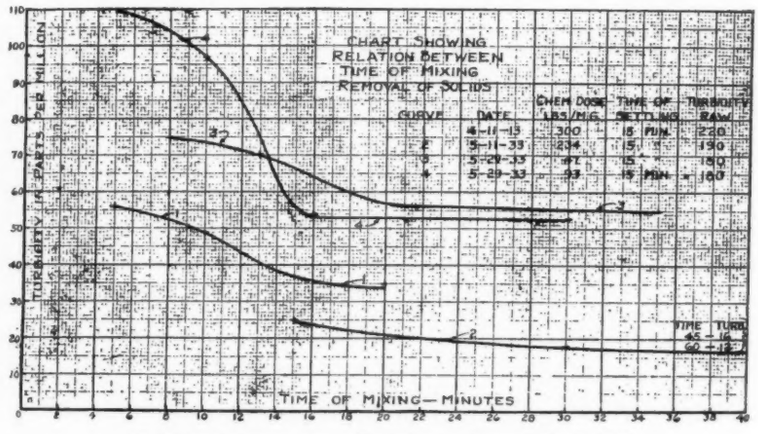
Discussion of the Freeport Study

The Basic Factors. In considering the results of chemical treatment, basic factors involved were considered as follows:

Character of Sewage:

(a) Results obtainable by other processes.

(b) Results obtainable by chemical treatment.



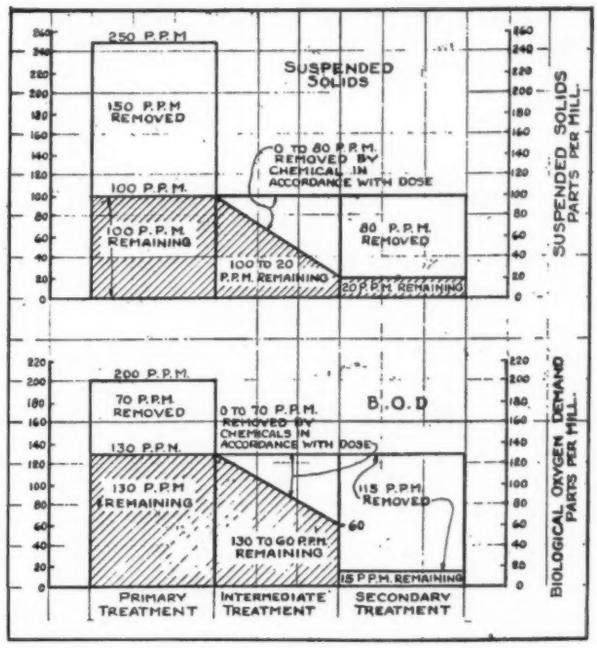
Relation between time of mixing and removal of solids.

Cost of chemical treatment.
Comparative costs of other methods.
Available chemicals.
Application of chemicals.

Character of Sewage: Freeport sewage at present is quite fresh and usually contains dissolved oxygen. Results of chemical treatment of this sewage would be more favorable than results of similar doses on stronger or older sewage. The sewage at Freeport will become stronger as the connected population increases. To estimate the chemical requirements of the future, the results were compared with similar figures on stronger sewage. Removals of suspended solids by plain sedimentation at other disposal plants illustrate what may be generally expected from preliminary treatment.

There are abundant operating results on the suspended matter and B.O.D. in raw and settled sewage and in the effluent of secondary treatment, but few figures are available showing the B.O.D. of non-settleable solids. Where chemical treatment is used, the determination of non-settling suspended solids and of the B.O.D. of the same and the B.O.D. in solution will be of value to show the true efficiency of the treatment. The degree of treatment may be varied as required. While a reduction in suspended solids equivalent to that effected by secondary treatment may be obtained by chemical treatment, the reduction in biological oxygen demand is not so complete. It is recognized that some reduction in dissolved B.O.D. may result from chemical treatment but it is believed such reduction will not materially change the results. For Freeport, it is expected that the B.O.D. of effluent from chemical treatment with prechlorination may be reduced to 50 ppm., even when the raw sewage is stronger and staler than at present. The capacity of secondary treatment units is related to the solid and organic load, and by the introduction of chemical treatment between primary and secondary treatment, the suspended solids applied to the secondary units may be reduced from 100 to 20, or 80%, and the B.O.D. load reduced from 130 to 60 or 75%.

The Cost of Chemical Treatment: The only additional equipment necessary for chemical treatment at Freeport will be a mixing chamber and a building for storing, handling and applying chemicals. It is planned that the mixing basin first installed shall have a capacity to provide for approximately 15 minutes of mixing for 2 m.g.d.



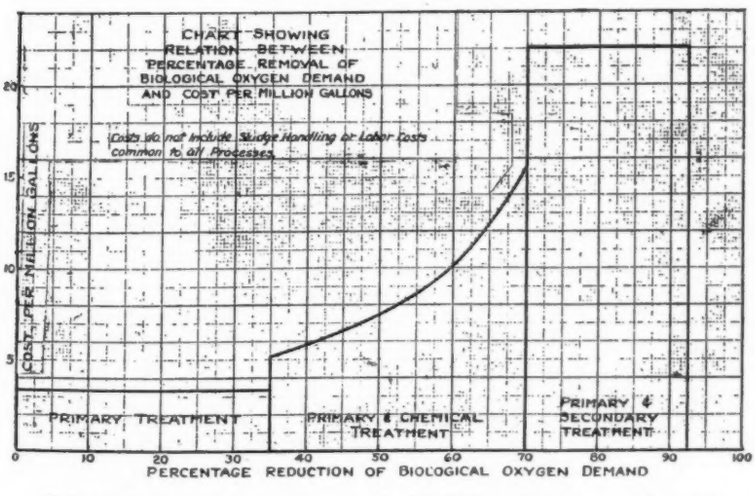
Average removal of suspended solids and B.O.D. by primary, intermediate and secondary treatment.

The estimated cost of building and appurtenances necessary is approximately $11,200. This building and equipment will be adequate until such time as the sewage flow will reach 8.63 m.g.d., estimated as about 1965.

The costs per million gallons will decrease with the size of the plant. For Freeport the estimated figures are as follows:

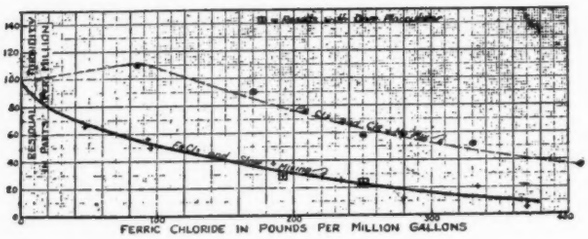
Capacity M.G.D.	*Chemical House*	*Mixing Basin*	*Total*	*Cost per Million Gallons per Day*
2	$11,200	$ 6,500	$17,700	$8,850
4	11,200	10,000	21,200	5,300
6	11,200	13,500	24,700	4,117
8	11,200	17,500	28,700	3,588

The cost of chemical applied is dependent upon the amount of removal desired, the character of the sewage and the chemicals used and method of applying them. Considerable variation in quantities of chemicals required are reported at various plants. From the study at Freeport and studies of the results elsewhere an estimate was made of the quantity of ferric chloride required for the average sewage to produce any desired B.O.D. in the effluent. The table shows the relation between cost of chemical and work done.



Relation between percentage removal of B.O.D. and cost per million gallons.

B.O.D. Effluent P.P.M.	*Ferric Chloride, lbs. per M.G.*	*Cost per M.G.D. @ 2c per lb.*
130	0	—
120	40	$ 0.80
110	80	1.60
100	120	2.40
90	175	3.50
80	250	5.00
70	400	8.00
60	500	10.00



Residual turbidity with various chemical doses.

Comparative Cost of Primary, Intermediate and Secondary Treatment: The following figures show the estimated cost per million gallons per day of a 2 m.g.d. plant for sewage treatment units with no allowance for sludge treatment. The operating cost does not include cost common to all processes.

Treatment	*First Cost*	*Int. & Amort. 7%*	*Operating*	*Total*
Primary	$17,500	$3.36		$3.36
Chemical	8,850	1.70	$0.80-$10.00	$2.50-$11.70
Secondary	50,000	9.60	$10.00	19.60

Chemicals Used: Ferric chloride is now commonly available at prices which make it attractive for sewage work. It has been determined by our experiments as a suitable chemical to meet our conditions. It may be used without lime. It is recommended, however, that provision for lime treatment be installed to provide adjustment of pH to be optimum for most efficient coagulation. In all our results it appeared that the optimum dosage of ferric chloride for the present sewage is 30 ppm.

As it is planned to prechlorinate the sewage, the use of chlorinated copperas was suggested by Mr. Enslow. In this process a solution of copperas is mixed with chlorine before application, forming ferric chloride and sulphate. We also considered the manufacture of ferric chloride from iron turnings and chlorine. The use of same showed a possible saving in the costs of ferric chloride, but in Freeport, where iron turnings are not available at low cost, this method was eliminated. During most of our experimental work, ferric chloride was used principally because of its convenience and applicability to our work.

For applying ferric chloride, a solution feed design used by the Toronto water plant some years ago has been suggested. In this a large hydrometer keeps the solution at constant strength by admitting water or chemical as the solution requires. We believe that, for a chemical treatment plant, the greatest possible flexibility should be provided together with ease of handling and operating.

A solution tank and a mixing box are provided for chlorinated copperas also. These solution tanks will also serve as standby units for the use of ferric chloride or other chemicals. Storage space is provided for all chemicals. This is of importance in order to obtain the saving possible by buying in carload lots.

We are convinced beyond any reasonable doubt that chemical treatment will solve economically our problem for sewage treatment in the Village of Freeport. We feel that we can use a large portion of our present plant for a good many years to come, if we use chemical treatment as an adjunct to our sewage treatment works in Freeport. We further feel that we can get almost any degree of treatment we desire for a corresponding expenditure of money.

Chemicals Used by Canadian Water Works

The mining, metallurgical and chemical branch of the Dominion Bureau of Statistics completed in November an investigation of the kinds and amounts of chemicals used in the municipal water supplies of Canada. Questionnaires were sent to the water works departments of 600 cities and towns.

Of these 600, only 165 reported the use of chemicals of any kind. During 1932, these 165 plants used 4,379 tons of aluminum sulphate, 444 tons of chlorine, 401 tons of lime, 168 tons of soda ash, 104 tons of liquid sulphur dioxide, 14 tons of ammonium sulphate, 10 tons of bleaching powder and 6 tons of activated carbon.

Aluminum sulphate was used by 30 plants in granular form, by 40 in lump form and by 12 in slab form.

The numbers of plants that use the several chemicals, alone or in combination with others, were as follows:

Chlorine only	76
Alum and chlorine only	50
Alum, chlorine and activated carbon	6
Alum, chlorine and ammonium sulphate	6
Alum, chlorine and lime	4
Alum, chlorine and bleaching powder	2
Alum, chlorine and soda ash	2
Alum, chlorine and sulphur dioxide	1
Alum, chlorine, lime and soda ash	1
Alum, bleaching powder and soda ash	1
Alum, bleaching powder, lime and soda ash	1
Alum, chlorine, activated carbon and soda ash	1
Alum and lime	2
Alum and bleaching powder	2
Chlorine and ammonium sulphate	1
Chlorine, bleaching powder and ammonium sulphate	1
Chlorine and copper sulphate	2
Bleaching powder only	6

RFC Funds for Improving Private Water Plant

The Wanakah (New York) Water Company during 1933 added considerably to its plant, using therefor a loan by the RFC, which was applied for in September, 1932, and the money actually received in April, 1933. The delay was due to the difficulty experienced in drawing a corporate mortgage and contract satisfactory to both the water company and the RFC. As finally agreed upon, these provided for selling $70,000 of second mortgage 6 per cent bonds for $63,000, of which $2,000 is paid off the first year, $4,000 the second, etc., for five years and $9,000 each of the next five years. This is equivalent to a 8.084% rate; but the low material cost last April offset the high rate.

Self-liquidating conditions were required. These included an increase of new customers and hydrant rentals assured by contract with the Town of Hamburg for hydrant rental for 54 hydrants, which will yield 45% of the interest and principal payments. Property served by these hydrants secured from the Fire Insurance Rating Organization a 70% reduction in insurance premiums, and this saving exceeds the additional tax for hydrants.

The improvements include a 250,000-gallon elevated tank, 24,000 ft. of 10″ pipe and 7,800 of 6″, U. S. Pipe & Foundry Co.'s de Lavaud pipe being used.

Financial History of Quincy, Illinois, Water Works

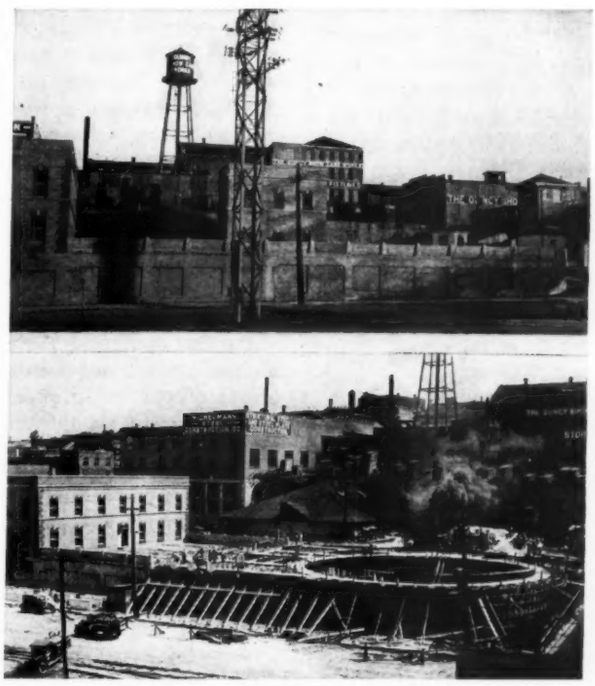
By W. R. Gelston
Superintendent of Water Dept.

IN 1825 Quincy, Ill., was platted as a town of about one half square mile area. At the time of the Chicago fire, 1871, it was a thriving industrial city of 24,000 people, who complacently drank beer, whisky, spring water and cistern water and relied on fire cisterns for water to supply its steam fire engine, purchased in 1866.

In 1870, 23 citizens died of typhoid fever; in 1875 typhoid carried off 53, 12 of them in one month. Alarm caused by the Chicago fire, with possibly some appreciation of the seriousness of the typhoid conditions, led the city to construct, in 1872, a water works plant comprising a steam pumping plant, 2,000 ft. of 6-in.-pipe and 3 fire hydrants. This was designed by Col. Edward Prince, a Quincy civil engineer, and for some reason the city in 1873 sold the works to a company organized by him and capitalized for $200,000, giving it a 30-year franchise. The company enlarged the system, and in 1882 built an 18 m.g. storage reservoir connected to the pumping station by 2½ miles of 16", 18" and 20" b. & s. pipe; and in the early nineties put into operation a 4 m.g.d. filter plant—one of the first of the mechanical gravity-type filters. About ten years later the iron and lime treatment of water was developed at Quincy.

Progress Toward City Ownership

In spite of the progressive policy of the company, there was continued controversy between it and the city officials, chiefly over the charge for fire protection, and the city decided that it should own its own plant, and in 1895 a water works sinking fund ordinance was adopted; but when the company's franchise expired in 1903 the sinking fund contained only $250,000, while the value of the plant was appraised by three prominent engineers at $649,159. As the city was in debt to its constitutional limit, the best it could do was to extend the franchise for a year, obtaining from the company the option to buy the plant within a year at the appraised valuation subject to adjustment for depreciation and any additions made during the year.



QUINCY SOFTING PLANT COMPLETED AND UNDER CONSTRUCTION.
Dorr clarifier on extreme right; old filtration plant at extreme left; between them, mixing chambers and recarbonation basin.

To overcome this difficulty, the corporation counsel (who was highly respected and had the confidence of the people), assisted by three Quincy banks, organized a holding company to buy the plant under the city's option and to operate it under a contract with the city which gave the city practically all of the benefits of municipal ownership. A brief outline of the financial set-up of this holding company might prove helpful to cities that are interested in buying their water plants.

The company was organized with a paid-up capital stock of $100,000, on which the city guaranteed the payment of 6% dividends. The balance of the purchase price was secured by selling $300,000 5% first mortgage bonds, and $250,000 6½% second mortgage bonds. The bond issues were divided in this particular manner to permit the use of the water works sinking fund, which could not legally be invested in the water works stock or bonds but could only be deposited in bank savings accounts. In its contract with the holding company, the city agreed to deposit this sinking fund in the three banks which were interested in the company, the bank to pay the city 5% interest on its sinking fund and to buy all of the second mortgage bonds. The first mortgage bonds were written with maturities coming due each year in amounts approximately equal to the amount of interest received by the city on its sinking fund. This interest was added each year to the principal. Then, new second mortgage bonds, drawing 6% interest, were issued to replace the maturing first mortgage bonds.

The holding company began operating the plant on October 1, 1904. Had the corporation counsel's plan been followed as he set it up, the first mortgage bonds ($300,000) would have been retired on October 1, 1920, the second mortgage bonds would have been increased to $550,000 and the city's water works sinking fund would have been increased to $550,000, sufficient to pay off the second mortgage bonds, leaving only the capital stock of $100,000 to be purchased to give the city possession of the plant. Under its contract with the holding company, the city had the right to buy the plant at any time at the value fixed by the appraisal engineers in 1903, regardless of any increase in the value of same by

the investment of surplus earnings in extensions and improvements. The city also had the right to fix rates, to order improvements, to order the use of surplus earnings in the redemption of bonds and to appoint one of the three directors of the water company. In fact, the stockholders got nothing out of it except a safe investment with the city guaranteeing the payment of 6% dividends on the stock and the interest on the bonds. The interest and dividends, of course, were paid out of the earnings of the plant.

This unique plan for making a $250,000 water works sinking fund buy a $650,000 water plant was not carried out as planned, for in the spring of 1916 an ambitious mayor asked the voters of the city to give the city officials authority to purchase the property under the option heretofore mentioned, the city having reduced its bonded indebtedness sufficiently to permit the financing of the deal. The vote was favorable and the final transfer to the city was made on October 1, 1916, after twelve years under the management of the holding company. The water works sinking fund had increased to $450,000, a bond issue of $130,000 was sold and the balance of the purchase price of $649,159 was found in the surplus earnings of the holding company.

The System Under City Ownership

The plant was placed in charge of a water works committee, consisting of three men appointed by the mayor with the approval of the City Council, two of whom had been directors of the holding company during the entire twelve years of holding company operation. The new commission retained the old operating force and the old rates have been continued up to the present time.

The value of the property, purchased by the city for $649,159, was fixed by Alvord, Burdick & Howson at $1,078,363. The only indebtedness against it was the $130,000 bond issue which had just been sold and which was paid off in five years. The present value of the plant, after nearly seventeen years of municipal operation, is $1,765,364. There is now a bonded indebtedness of $119,000, or less than seven per cent of the value of the property, the balance outstanding on a bond issue of $205,000 which was sold in 1925 to secure money with which to place a concrete lining in and a concrete roof over the 18,000,000-gallon storage reservoir. The sale of this bond issue should not have been necessary, for previous to the completion of this reservoir work, the City Council had taken $266,000 from the water works surplus earnings and used it for other municipal purposes.

The city does not pay for any water used by the city buildings or departments, or for fire protection. Parks, cemeteries and hospitals have free water. Schools pay five cents per thousand gallons. In addition to this free service, the city has, since 1919, used $666,000 of water works earnings for purposes other than water department expense.

The last annual report of the water department shows free service and fire protection furnished the city, valued at $79,154, and $95,000 cash transferred to the city treasurer and used by the city; a total of service and cash for one year of $174,154. The water department pays no state, county or city taxes. The rate of taxes in Quincy for the last year was $3.77 per hundred on one half of the value of taxable property, and the water department taxes, figured on that basis could not have been more than $33,277. Adding seven percent returns on the taxpayers' original investment of $450,000 (the amount of the water works sinking fund on October 1, 1916), or $31,500, gives a total of fixed charges against the plant of $64,777. Deducting this amount from the value of the cash and free service leaves a balance of $109,377 in the taxpayers' favor from one year's operation.

Present Operating Conditions

Operating costs are comparatively high. All of the water is pumped twice at the river pumping station, a first lift to the purification plant of 55 feet when the river is at the zero stage, while the filtered water is pumped against a head of 250 feet to the reservoir. Here 15% of all filtered water pumped at the river station is again pumped against a head of 130 feet into an elevated tank. The purification process includes coagulation, agitation, softening, sedimentation, recarbonation, sterilization, odor and taste removal and filtration. The water department lays and maintains all street mains and also the services to and including curb stop and box. The department also owns and maintains all meters.

The present water rates were put into effect by the old Quincy Water Works Company. A few months after the city bought the plant some of the city officials requested a reduction in rates but the water commissioners persuaded them to leave the rates as they were until certain needed improvements had been made. Then the war increased operating costs and the revenue from saloon licenses was lost to the city, and water works surplus earnings became so important in the financial operations of the city that the proposed change in rates never has been made. The rates are on a sliding scale from 45 cents to 5 cents per thousand gallons. Eighty-seven per cent of the services are metered and flat rates are permitted only on residence services.

There are no free services except the city and charitable institutions already mentioned. Everybody pays for water and payment has always been enforced by a judicious use of the pave key until the present depression. Even under present conditions, there is less than $3,000 outstanding in delinquent bills.

Politics cannot be entirely eliminated from any municipal project and political interference usually means increased operating expenses. Fortunately, the Quincy water department has been allowed to hire and fire its employees and very few have ever been fired. The department has always made its own construction and material contracts.

The 18,000,000-gallon storage reservoir has made possible the purchase of off-peak electric power for the operation of the river pumping station and purification plant at a low rate of three quarters of a cent per kilowatt hour.

And finally, the plant has never been burdened with excessive indebtedness. A "Pay As You Go" policy should be an economical policy, even for a city.

Wisconsin's Sewer Rental Law

Chapter 133, Wisconsin laws of 1933, permits municipalities to finance their sewerage service, in whole or in part, through rental charges to property holders, and the cost of intercepting sewers and sewage treatment works may be included in the financing plan. It was expected that a number of municipalities would make use of this statute in financing sewage treatment projects under the federal public works program.

The Editor's Page

Turning Back the Clock a Generation

Since the first publication, last July, of the policies and rules under which the PWA was to operate, we have consistently opposed the principle that "the maximum of human labor shall be used in lieu of machinery" as antagonistic to the best interests of every person and interest concerned. We have given our reasons in these pages from time to time: It is wastful of taxpayers' money, since several times as much work could be accomplished if the same number of men used modern equipment instead of hand shovels and wheelbarrows; it excludes from the benefits all mechanics and others in the equipment industry, crippling that industry against the time when it will be needed to cooperate in construction by normal methods; it produces in only a less degree the objectionable effects upon morale resulting from the dole, since the men realize that they are working inefficiently no matter how much muscle they put into it, under which conditions only the most conscientious could be expected to make much effort; and to the extent that it teaches the laborers anything, it teaches them methods they had best forget as quickly as possible.

As an illustration of the last point, the editor has received a letter from one who is preparing a short correspondence course for unemployed men, PWA workers, on "Construction of Sewers," asking permission to quote several pages from the sixth edition of "Sewerage" (published 24 years ago) because the later ones do not "deal extensively with the type of hand construction to be used on PWA jobs." Not only using, but teaching methods of a generation ago seems to us a poor way to get back to normal. And certainly, whatever excuse there may have been six months ago for pulling at our own boot straps to lift us out of the slough of despond, we now should feel that we are standing on firm ground and should have sufficient hope and confidence to anticipate a return to efficient and economical use of modern methods in performing public work as well as private. Even the excess-producing farmers are not asked to plow with forked sticks. Why should public works be asked to turn back the clock?

We had thought that the PWA heads were realizing that the all-hand-labor idea was a mistake and were allowing it to sink into oblivion. We hope we were not mistaken.

We cannot get back to normal conditions by following subnormal methods. We can not make much forward progress by walking backward.

Automobile Improvements and Highway Design

Some discussions of our editorial in the December issue on this general subject have been received from our readers. These are of interest, and indicate the general importance of the subject. However, the recent announcement on the part of one of the largest manufacturers of automobiles, is of greatest interest.

The new "knee-action" front wheels, if and when applied to trucks, should greatly reduce the amount of damage to highways through impact. As a consequence, it is entirely possible that a 5-ton truck with such equipment will not damage a road as severely as a truck of present design of one half the weight.

Allowance for impact greatly increases the load factor in the design of bridges and highways. If this factor can be reduced, so can costs of construction.

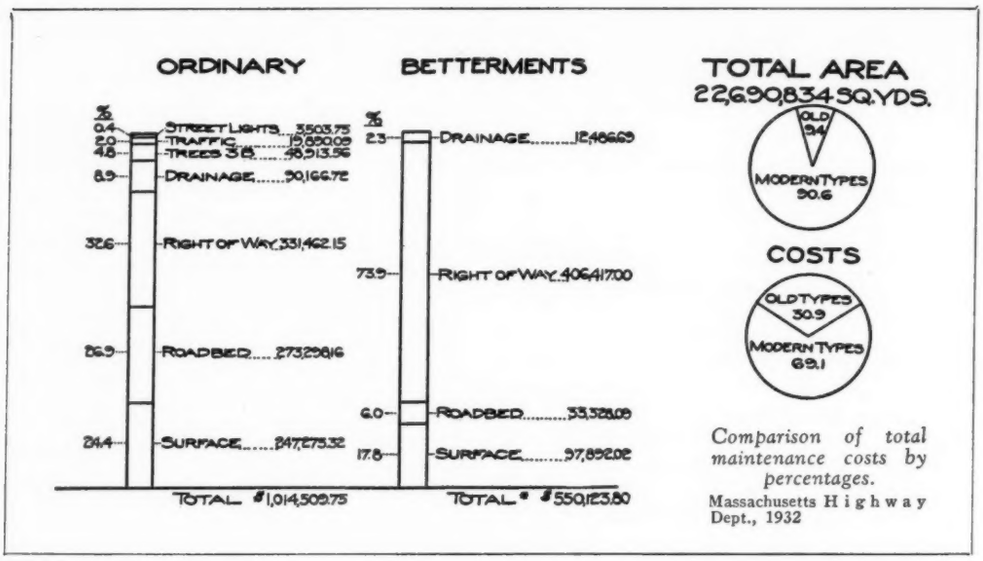
Why Must the Automobile User Be the Tax Goat?

Probably there never was a tax that came as near to being popular as that on gasoline. There was little complaint against it even when it reached 4 or 5 cents a gallon so long as the proceeds were used solely for highway purposes. Although it was a class tax, the individuals constituting that class realized that it was being spent for their benefit, and on the whole was being spent wisely and economically. It was popular with the law makers also because it made few enemies among the voters, yielded enormous returns for little effort on their part, and was easy to collect and difficult to evade. It is not surprising, therefore, that, when larger state incomes were needed, attention should be turned to the "easy mark"—the automobile owner. Not surprising, perhaps, but unjust and invidious, for it taxed one class excessively for services shared equally by all classes.

The last two or three years have seen an increasing amount of this diversion of gasoline taxes, with more or less grumbling by automobilists but no general uprising. But recent threats and legislative actions certainly should make them sit up and take notice. The latest at this writing is the message of the governor of New Jersey to the state legislature on January 8th recommending that not a cent derived from gasoline taxes or automobile license fees be used for highway work, but all for education, to relieve the cities and towns of a considerable part of the burden of supporting their schools. (The governor would have the state spend on highways only funds provided by the Federal government.)

How much of the revenue from gasoline taxes has been diverted from highway work it has been found impossible to learn. A number of states refuse the information. In some, part of these funds is "borrowed" for use by other departments. Probably a fair estimate for 1933 is $100,000,000. Some estimate as high as $500,000,000, but this includes amounts allotted to cities for street work and other uses which we would not class as diversion, and, is, we feel sure, too high. But if plans announced in a great many of the states are put through their legislatures, highway work this year and next will constitute but an incidental use of these funds.

A perfectly just and equitable tax probably is impossible of assessment; but asking automobilists as such to finance our state governments is a wide departure from this for which there is no excuse except that they will stand for it. Will they? And for how long? About a half of the voters of the country own automobiles. When they get tired of being the goat and tell their legislators so, this inequitable diversion of gasoline taxes will cease.



Costs of Surface Maintenance of Pavements

By W. A. Hardenbergh

GENERAL highway maintenance, as defined by the Bureau of Public Roads "is the function of preserving and keeping each type of roadway, structure and facilities as near as possible in their original condition as constructed, or as subsequently improved to produce satisfactory service. General maintenance does not include reconstruction or additions and betterments."

Operating maintenance has nothing to do with general maintenance of the highway proper but includes expenses of traffic control and traffic surveys, traffic signs, traffic policing, snow removal, administration, etc.

Confusion in computing and comparing maintenance costs lies in the fact that many states not only make no distinction between general maintenance and operating maintenance as defined, but also include betterments in varying degrees as maintenance charges.

It is important that a further segregation of general maintenance be made so that in one group shall be included only the maintenance of the surface or pavement and the base and the maintenance of the shoulders involving no improvement or betterment, and in the second group the remaining items under general maintenance. This first group might be termed "type maintenance" and would be the principal item in general maintenance as defined. Thus, by starting with type maintenance and following with the other groups of general maintenance and operating maintenance, a complete and comparable set of costs are set up which will permit comparisons, point to opportunities for economy and afford genuine evaluation of initial construction projects.

General Maintenance vs. Betterments

Most important is the distinction between general maintenance and *betterments*. If yardage is added to the road surface as a result of widening, the community has added value to its highway investment. If a road is improved by such work so that it is definitely a higher type of surface, it is worth more. Charges resulting from work of this type should not be entered as maintenance, but as betterments. The same is true if a new bridge or culvert is built, or if the roadbed drainage or alignment is improved.

A number of state highway departments do make such distinctions. The Minnesota classification is shown in a box on another page. Oregon states: "Betterments include all improvements of a material nature that are made upon the highways subsequent to the period of initial construction. Included in this are the widening and straightening of roadbeds, the improvements of foundations and drainage, the widening and thickening of pavements, the non-skid treatment of pavements, the change from a lower to a higher type of surface, the erection of guard fence, the replacement of wood structures by structures of a more permanent type, the planting of trees and shrubs along the highways, etc."

Illinois also has provision for the construction of betterments after the original construction work has been completed, but a special request must be initiated for authorization of this work. Maintenance costs are also subdivided into "maintenance of wearing surface" and "upkeep of roadside."

Idaho, in a recent annual report, states: "Roadway work which will increase the capital investment or reproduction cost is considered as a betterment. Work which does not raise the type is classified as maintenance or reconstruction. A gravel surface laid on a graded and drained road would be considered a betterment, while widening and flattening of curves would be considered reconstruction. If gravel is originally placed and surface treated, the first treatment would be charged to betterment, but subsequent surface treatments are chargeable to general maintenance. Some latitude is permitted in the distribution of charges and the decision in some cases is colored by the source and availability of funds."

In the last sentence of the preceding paragraph lies the explanation of the unreliability of so many mainten-

ance data, though few states are frank enough to admit it. After all, no matter how carefully tabulated or how well prepared, the figures given are no better than the foreman or the maintenance superintendent who turns in the basic data from which they are prepared. In some states, lump sums, based on estimates prepared in advance of the fiscal year, are allotted to various sections for maintenance purposes and can be spent only on them. It is but natural in such cases to classify the charges in accordance with allotments available rather than with the exact nature of the expenditures for labor and materials.

Massachusetts has an excellent method of securing and tabulating the cost of work done by the maintenance forces, which will be described in detail.

The Massachusetts Classification in Detail

The general classification is: 1. Surface maintenance. 2. Other maintenance. 3. Betterments.

Surface Maintenance.—Under this head are included costs of all repairs and surface treatments necessary for keeping the surface in good condition for carrying traffic, such as, and including, patches, crack filling, replacement of defective areas, and re-treating to maintain the surface in a satisfactory travelable condition.

Other Maintenance.—Under this are placed costs of shoulder maintenance; repairs to and maintenance of the foundation and roadbed (as required by frost action, settlement of fills, etc.); bridge, culvert, catch-basin and other drainage maintenance; repair of slopes on right of way; guard rail repair, brush trimming and cutting, mowing—in fact everything aside from surface maintenance. Striping and lining for traffic control and the maintenance of traffic signs and signals are also included.

Betterments.—a. Surface: In this item are charged all costs of widening, such as for areas or driveways or to make the surface wider; extensions or other work whereby the area of the original surface is increased or permanent improvements made in it. (When the type of road is changed, the original road is charged off and brought under the new classification.)

b. Roadbed: Costs under this head are for any work tending to improve permanently the road bed or any part of it, such as widening, etc.

c. Drainage: Costs for larger or wider culverts or bridges, new catch-basins or inlets, etc., come under this head.

d. Right of Way: Costs of new guard rails, revetment, rip-rap, curbs, retaining walls, sodding and improvement of slopes, etc., would come under this classification.

e. Traffic Control: Costs for new signs and signals.

Other Factors in Maintenance Costs

The volume of traffic is very important. Yet with few exceptions it is perhaps safe to assume that a surface built 20 years ago was placed on a fairly important road. New routes, since constructed, may have diverted some of the traffic, of course, but roads built 20 years ago were generally in fairly populous areas, and so would naturally carry a considerable traffic.

There are many other factors which intervene to make the comparison of maintenance costs difficult. The age of the surface is important, both because all roads wear out sooner or later, and, probably even more because of the progress in road building. That is, a road built in 1915 cannot be compared with a road built in 1930 any more than a 1915 model automobile can be compared with a 1930 model. They are built to different standards and on a different engineering basis. Let us compare two bituminous macadam Massachusetts roads of widely different ages, on which cost data are available.

Trunk Highway Maintenance Analysis of Expenditures

Minnesota Highway Department

	1930
GENERAL MAINT. OF ROADWAY	
(Including Shoulders)	
Smoothing Surface or shoulders	$963,237.85
Surface patching and repair	515,238.61
Reshaping	65,664.37
Scarifying	19,385.93
Regravelling, stock piling, etc.	311,951.43
Rebuilding shoulders	4,029.18
Filling-in roadway	8,867.65
Planking, metalrut, etc.	23,246.56
Calcium chloride treatment	38,307.96
Bituminous re-treatment	296,632.72
Miscellaneous expense	2,652.63
Total	$2,249,214.89
GENERAL MAINT. OF STRUCTURES AND RIGHT-OF-WAY	
Cleaning culverts and ditches	$78,648.76
Culvert repair and replacement	6,036.61
Mowing, cutting weeds, clearing, etc.	189,017.33
Major washout and sand drift repairs	44,968.25
Repairing and painting bridges	59,377.70
Erecting temporary and removing old bridges	222.17
Guard rail repair	29,185.79
Miscellaneous expense	4,061.64
Total	$411,518.25
BETTERMENTS	
Grading, intersect., crossing imp'm'ts	$78,309.04
New gravelling	73,735.39
New culverts and culvert extension	21,525.59
Erection of new guard rail	1,369.38
Bridge widening and new structures	26,870.81
Installing curb and spillways	2,418.70
Offtakes, tiling, hand ditching	78,261.60
Rip-rap, revetments, retaining walls	6,426.64
Original bituminous treatment	298,918.08
Sodding, seeding shoulders	1,814.95
Miscellaneous expense	1,086.05
Total	$590,736.23
SPECIAL MAINTENANCE	
Marking highways, signs and markers	$81,993.00
Traffic control and safety devices	14,219.74
Purchase of lands for gravel, etc.	391.64
Purchase and construction of plants, buildings and sites	32,491.18
Snow plowing and removal	229,520.16
Snow fence purchase and handling	141,661.82
Traffic census	13,908.85
Fire fighting	281.99
Field materials and stores	.....
Miscellaneous expense	41,258.84
Total	$555,727.22
PRORATION	
Administration salaries	$178,150.47
Office expense	18,691.98
Field supervision expense	57,089.87
Workmen's compensation	17,187.43
Patrol aid force	97,579.74
Miscellaneous expense	Cr. 11,506.50
Total	$357,192.99
Grand total	$4,164,389.58

Cost of Surface Maintenance per Sq. Yard of Surface

Year Built	*Yardage*	*Average per year since construction*	*for 1932*
1912-13	15,317	$0.025	$0.0001
1929-30	42,576	.0008	.0000

These older roads were not constructed to the standards of width, grade and alignment that are demanded today; nor was the foundation or subbase so carefully and thoroughly built. If improvements to these items be made, such as widening on curves, adding to the width, etc., the older road is very heavily penalized in the comparison of maintenance costs unless extreme care is taken in compiling the basic data for such costs.

On the other hand, the roads constructed in the golden

days of 1929 and 1930, when the procurement of construction money was the least worry of the highway engineer, had everything but sex appeal. Consequently surface maintenance, as already defined, is just about the only necessary expenditure on it today—or should be.

Thus, any comparison of total costs of work done on highways, if differentiation is not made of the various items of expenditure, is going to be untrue and unfair. The costs incident to building a road with a wider surface, a better alignment, etc., are a part of the original cost of that road; they should correspondingly be charged as cost on another road where such conditions were obtained by work done years after construction, though it be done with maintenance funds or by the maintenance forces.

Massachusetts Maintenance Costs

Costs prepared in accordance with the above ideas are available for a period of years on Massachusetts state highways. Below are given these costs for a number of types of pavements. The figures given refer only to surface maintenance costs, per square yard, for the entire yardage of these types in the state highway system during the year in question.

Year	*Cement Concrete*	*Dual Type*	*Bituminous Concrete*	*Bituminous Macadam*	*Gravel*	*Waterbound Macadam*
1921	$0.0112	.....	$0.0105	$0.0230	$0.0761	$.1035
1922	.0101	.....	.0111	.0203	.0854	.0875
1923	.0104	.....	.0177	.0285	.1076	.0983
1924	.0148	.....	.0195	.0328	.1017	.0904
1925	.0123	.....	.0218	.0200	.0856	.0863
1926	.0123	.0343	.0134	.0175	.0718	.0680
1927	.014	.004	.013	.020	.050	.053
1928	.015	.005	.012	.016	.075	.058
1929	.017	.008	.009	.014	.048	.059
1930	.014	.005	.011	.010	.059	.057
1931	.011	.003	.010	.007	.045	.057
1932	.008	.002	.011	.006	.045	.035

These figures are of great interest, and bring out several of the points already mentioned. The low figures on dual type show the effect that age, or lack of age, has on costs. None of this pavement is more than 7 years old.

The great rising tide of traffic and its effect on highway maintenance costs is shown graphically in the record from 1921 to about 1926. By the end of this period, highway engineers had been able to devise methods of combatting the wear and tear due to high speeds, and very much heavier traffic. Prior to 1923, road speeds did not average in excess of 35 or 40 miles an hour, but thereafter climbed rapidly, affecting correspondingly the maintenance costs.

In order to bring out more clearly the effect of age, there is given below a tabulation of the amount of each type of surface (mentioned in the table above) in service each year. The differences in these figures do not show exactly the amount of new construction for each year, because there has been withdrawn from each type some yardage due to construction or reconstruction, change of type, etc., especially in the lower types.

Year	*Cement Concrete*	*Dual Type*	*Bituminous Concrete*	*Bituminous Macadam*	*Gravel*	*Waterbound Macadam*
1922	1,056,908	.....	1,771,333	2,752,281	1,298,263	3,987,707
1923	1,321,741	.....	1,742,166	3,079,610	1,260,719	3,490,727
1924	1,556,206	.....	1,896,487	3,480,901	1,271,237	3,829,268
1925	1,996,944	.....	2,233,580	3,903,376	1,279,019	3,443,779
1926	2,367,418	62,483	2,275,629	4,283,949	1,225,932	3,190,906
1927	2,627,882	62,483	2,419,174	4,963,776	1,080,449	3,017,542
1928	2,770,203	90,858	2,623,562	6,062,963	930,242	2,420,544
1929	2,899,837	155,058	2,749,951	7,287,904	834,209	2,129,061
1930	3,034,116	184,539	2,805,968	8,653,134	565,291	1,880,628
1931	3,708,269	435,724	3,083,714	9,406,616	585,424	1,654,043
1932	4,458,808	716,864	3,085,670	10,500,128	491,002	1,512,086

Considering the first four types mentioned above, it will be seen that practically all of the dual type has been constructed since 1926; that approximately one half of the cement concrete and about 60% of the bituminous macadam has been built since that time; and about one-fourth of the bituminous concrete. Gravel and waterbound macadam have decreased. Quite likely their removal from the roads carrying heavier traffic has been responsible for decreased maintenance costs as shown in the preceding table.

Betterments as an Added Value

The segregation of betterments from ordinary maintenance costs should be of value in showing that a fair proportion of the amount ordinarily set aside for maintenance is, in effect, used to increase the value of the state's investment in roads. Of a total expenditure for maintenance in 1932 of $1,564,635.55, Massachusetts spent $550,123.80 for betterments. Only $247,275.32 went into ordinary maintenance of the surface. The chart herewith shows the amounts and percentages spent in 1932.

The Minnesota analysis for 1930 shows that, of a total expenditure of $4,164,389.58 for maintenance and proration of overhead, betterments totalled $590,736.23.

These facts, where they are available, might well be used to combat the charges so frequently made that the upkeep of a modern highways system—to accommodate the demands of travel alone—is excessive, and often beyond the capacity of the community to pay.

A Handy Cement Shed

The bridge-repair crew of Warren County, Ind., stores cement at concrete jobs in a 6x6x5-ft. sectional shed. The shed is made up of six parts—a platform floor, four sides and a roof. The sides are doweled and fastened by plates to the floor, and to each other at the corners. The roof is grooved and hooked to the sides. This shed holds more than 90 sacks of cement. It can be taken down or erected in a few minutes. In two years the bridge crew has not lost as a result of weather conditions a single sack of cement stored in the shed. Labor and materials to build the shed cost $52.50.

The Digestion Tank

A Digest of the Sewerage Literature of the Month

HEATING digestion tanks is becoming more and more common practice, but little is known regarding the rate of heat transfer between the heating coils and the sludge. From studies made at Pennsylvania State College[13] conclusions were reached that: "1—Sludge has a relatively low heat transfer coefficient from a heating coil on account of its high viscosity. 2—Heating is most advantageous in the region of active digestion, because that is the point where the heat is most useful and the sludge heat transfer coefficient is the highest. 3—With the heating water temperature around 130° to 140°F, the heating coils will remain quite free from incrustation. 4—Using water as the heating medium, the heating requirements can be varied to meet the climatic conditions by a variable speed circulating pump. 5—Heating coils should be spaced 15 to 24 inches upon centers in the heating regions."

Rudolfs and Mills found the region of active digestion to be located at a distance above the bottom of the tank equal to about 50 to 60% of the sludge height. It would be unwise to place pipes higher than 60%, but a second bank might be placed between 35 and 50%, and a third in the 25 to 35% height region. Below 25% they would be useless.

Besselievre reported the average number of coils to be 4, maximum 6 and minimum 2; and that pipe at least 1½ in. diameter was considered desirable. He believed that if the temperature of the ingoing water did not exceed 140°F, caking of sludge on the pipe would not occur to a noticeable degree. Insulation around the tank is desirable. J. F. Laboon suggested cork. C. C. Agar told of the use of hollow tile. Mr. Queer said "Cinders used in 24 to 30-inch thickness offer considerable resistance to heat-flow if they are well drained."

In New York State, heated digestion tanks are kept at a temperature of about 80°.[21] Half of the 22 digestion plants are heated, using coils and recirculating hot water pump. Temperatures in unheated tanks have dropped as low as 37° (Huntington), and 42° to 45° are common, showing practically no digestion during winter months.

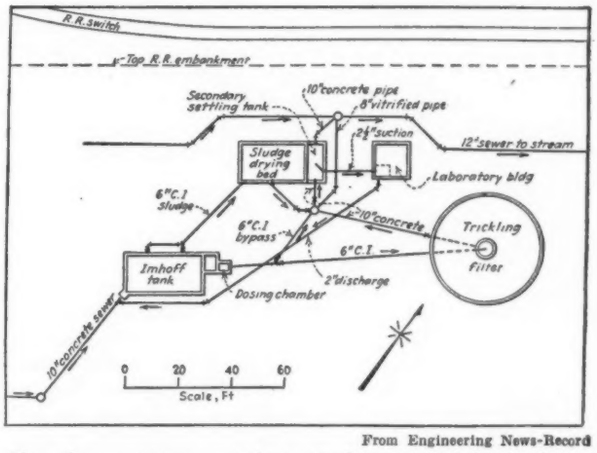
An *institutional sewage plant* treating domestic sewage from 500 persons at the Indiana Girls' School is unusually complete, comprising Imhoff tank, trickling filter with rotating distributor, secondary settling tank, glass-covered sludge drying bed of 200 sq. ft. area, laboratory and chlorination equipment.[25] The total cost was $13,960, including engineering and all equipment. Its operation requires the attention of one operator 30 to 45 min. each day for six days and 3 to 4 hours on the seventh day. Daily the operator notes and records depth of scum and sludge, area of drying bed in use, settleable solids and pH at various points, etc.; squeegees the tank walls and slots, skims tanks and breaks up scum, weighs and records amount of chlorine used, etc. During 1932 the tank reduced the settleable solids an average of 73.4% on laundry days and 82.6% on all others. (The load was 57% greater on wash days.)

Sprinkling filter media were studied, as to effect of type and size, by Rudolfs and Heukelekian for 2½ years by means of an experimental filter.[11] The rate of flow was uniform at 1.96 mgd. per acre. Type experiments were made on stone, slag and gravel of 1½ inch size. The greatest variation in discharges of suspended solids occurred with stone and the least with gravel. Unloading varied, slag retaining solids to a greater extent than the other media, amounting to about 2½ times as much organic matter expressed in population equivalents. Small sizes of stone and slag were about equal in general purification and large sizes very nearly so.

There was marked difference in efficiencies of coarse and fine material (1 in. and 2½ in.). Ammonia and B. Coli reduction and nitrate formations were persistently greater in the smaller materials. "Indications were that with 2½ in. stone a filter bed must be several feet deeper than a bed with 1 in. stone, to produce equal nitrification."

Winter maintenance of filters is more difficult than summer. Filter "clogging is usually confined to a period of two or three months during the middle and late winter season."[21] Remedy, punch holes at intervals through top layer of stone. Ice formation on a bed is much less when nozzles of the flat-spray type are used. Freezing of distributors is minimized by using bleeder valves in the distribution system, or slightly opening a filter bypass valve.

Activated sludge is being disposed of at Barnsley (England) by mixing it with "fine ground material, such as clay, clinker ash, sand, crushed stone, etc., and



From Engineering News-Record

Plan of sewage-treatment plant at Indiana Girls' School, which includes a reversible-flow Imhoff tank and a circular trickling filter equipped with a rotating distributor arm.

burnt sludge ash has been used with good results."[7] Such a process has been in use for 500,000 gpd. since August, 1932. The fine material is mixed with the sludge in a mixer and the mixture passed into a settling tank, and the liquid drawn off by a floating arm in half an hour. The sludge, originally 99.37% moisture, is reduced in bulk 72%, and the moisture content reduced to 94.5%. This is run onto drying beds, and the moisture reduced to 80% in five days, "even under showery conditions"; then, shoveled onto a dump, it continued to dewater to 70% in twenty days. The plant is to be increased to dry all the surplus sludge, a bed area of one square yard for 19 persons being provided.

Vacuum filters operate satisfactorily[15] if (1) the sludge is of such character and in such condition that a ready separation of suspended solids from liquid can take place; (2) the sludge contains sufficient suspended matter for the formation, in a relatively short time, of a cake or mat of sufficient thickness and body to allow easy and complete removal from the filter cloth or medium; (3) if the character of the solids is such as to allow the liquid to be forced through the mat formed on the filter medium by the pressure differential between the atmospheric pressure on the outside of the mat and the evacuated section beneath the mat; and (4) if the cake formed has sufficient porosity to allow air to pass through it during the drying cycle and thus reduce the surface moisture.

The first is the most important and may require conditioning. Practically all sewage sludges can be made suitable for filtering if sufficient conditioner be used, but the cost of this may make filtering uneconomical. (At Baltimore the cost of conditioner was more than half the total cost of dewatering; in spite of which the cost of dewatering on vacuum filters was less than on sludge beds.)

It seems possible that, if sludge be removed from a digestion tank continuously for filtering, the tank capacity might be reduced; the digestion could be only partial—in fact, might be dispensed with entirely, although it might be economical to use a small tank to reduce the peak load on the filter and so reduce its size.

"Activated sludge plants with sufficient suspended solids in the plant influent to require primary sedimentation, and with a total daily solids warranting incineration, show from our theoretical comparative balances lower first and operating costs if designed with digesters for the primary solids and provision for mixing the raw, waste activated sludge with the digested solids before filtration." Sludge from digestion tanks treating mixed activated and raw sludges shows a conditioner demand which makes filtering uneconomical. Possibly this can be solved by two-stage digestion.

"Most chemically precipitated sludges filter readily, particularly those in which lime is a large percentage of the chemicals added."

Sewer rental laws have been adopted by at least 35 states, the enactment of them having been materially spurred by the aid offered by the Federal Government through the R. F. C. and the N. R. A.[16] Some state laws include power to collect from users a periodic rental "to pay for the maintenance and operation of the sewerage system, to establish a depreciation fund, and to provide revenues to pay interest on and retire bonded indebtedness," while others limit this to expenses of operation, maintenance and repair, including interest on indebtedness. Childs and Schroepfer believe that "the rates or charges are best limited to maintenance and operation costs, because this enables municipalities to keep rentals at a low figure and requires the installation costs to be paid by general taxation"; which is just, since a sewerage system increases the value of vacant property and benefits the health of the whole community.

Rental rates in Indiana must suffice each year to pay the proper and reasonable expense of operation, repair, replacements and maintenance, and maintain a sinking fund to meet interest charges, pay bonds when due, and provide a margin of safety equal to 10% of all other payments into the fund. The rates at Bloomington are 12.5 cts. per 1,000 gallons for the first 2,000 gal. per month, 10 cts. for the next 3,000, down to 2 cts. for all over 600,000 gal. per month.[17] The charge for 52% of all the sewer users is 45 cts. per month or less, which is the maximum for 70% of residential users. The Bloomington charges for residences are between 25% and 30% of the water service costs.

Biography of Recent Sewerage Literature

c, Indicates construction article; *n*, *note or short article*; *t*, technical article.

The Surveyor, November 17.

1. Gravesend's New Main Drainage System, pp. 439-441.

November 24

2. Wolverhampton Sewage Disposal, pp. 471-473.
3. Logical Design of Separate Sludge Digestion Plant. By A. S. Lowe, p. 478.
4. The Re-sewerage of Guildford. By J. W. Hipwood, pp. 483-484.

December 1

5. Recovery and Utilization of Sludge Digestion Gas. By Franz Fries, p. 499.
6. Chemical Sewage Purification. By George H. Gleason and Alfred C. Loonam, pp. 501-502.
7. The Disposal of Surplus Activated Sludge. By H. D. Bell, p. 513.
8. Importance of Research Work in Sewage Disposal, p. 514.
9. A Flexible Joint for Concrete Pipes. pp. 533-534.
10. *n.* Sewage Analysis (Editorial), p. 525.

Sewage Works Journal, November.

11. *t.* Type and Size of Sprinkling Filter Media. By Willem Rudolfs, L. R. Setter and H. Heukelekian, pp. 901-922.
12. *t.* The Oxygen Demand Test and Its Application to Sewage Treatment. By J. K. Hoskins, pp. 923-936.
13. *t.* Heat Transmission in Sludge. By E. R. Queer, pp. 937-946.
14. *t.* Laboratory Studies of the Activated Sludge Process by Mechanical Apparatus. By R. A. Voelker, pp. 947-956.
15. The Mechanical Dewatering of Sewage Sludge on Vacuum Filters. By E. D. Flynn, pp. 957-966.
16. Application of the Sewer Rental Law. By John H. Fertig, pp. 967-977.
17. Revenue Bonds and Sewer Service Charges at Bloomington, Ind. By Carl B. Carpenter, pp. 978-984.
18. Delinquencies in Sewer Service Accounts. By W. W. Morehouse, pp. 985-987.
19. Selling Sewage Treatment. By Gus H. Radebaugh, pp. 988-997.
20. Excessive Ground Water in a Sewer System and Its Effect on Sewage Plant Operation. By C. A. Emerson, Jr., pp. 998-1006.
21. Operating Experiences in New York State. By Chas. C. Agar, pp. 1007-1020.
22. Sewage Collection and Disposal at Lancaster. By J. F. Laboon, pp. 1021-1032.
23. Sewage Treatment and Fish Life. By Carl L. Hubbs, pp. 1033-1040.

Engineering News-Record, November 23.

24. Elimination of Odors in Sewage Treatment Works, p. 621.

November 30

25. Designing and Operating a Small Sewage Plant. By Lynn J. Arthur, pp. 645-648.
26. Sewers Tested for Tightness by Measuring Outward Leakage. By H. R. F. Helland, p. 659.

December 7

27. Chemical Sewage-Treatment Methods Reviewed and Appraised, pp. 676-677.
28. Reducing the Toxicity of Cyanide Wastes. By E. F. Eldridge, p. 677.

December 14

29. Sanitary Improvement Program Solves Pollution Problem. By T. B. Henry, pp. 703-705.

The Canadian Engineer, November 21.

30. Utilization of Sludge Digestion Gas, p. 11.

November 28

31. Proposed $25,000,000 Sewage Disposal Plant for Toronto, pp. 11-14.

December 5

32. *n.* Winnipeg Plans Sewage Disposal, p. 12.

The U. S. Piper, December.

33. Sewage Disposal Plant at Akron, O., Uses Cast Iron Pipe, pp. 62-64, 69.

The American City, December.

34. Disposal of Sewage Sludge by Incineration. By T. R. Kendall, pp. 39-40.

Municipal Sanitation, December.

35. Sewage Treatment in Japan. By Isador W. Mendelsohn, pp. 406-408.
36. Measuring Sewage at Providence. By Chas. G. Richardson, pp. 409-410.

Public Works, December.

37. Heating Sludge Beds, p. 20.
38. Cleaning Activated Sludge Air Diffusers, p. 24.
39. The Digestion Tank, pp. 29-32.
40. *n.* Difficult Sewer Siphon Construction, p. 26.

THE WATER WHEEL

FOLLOWING are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.

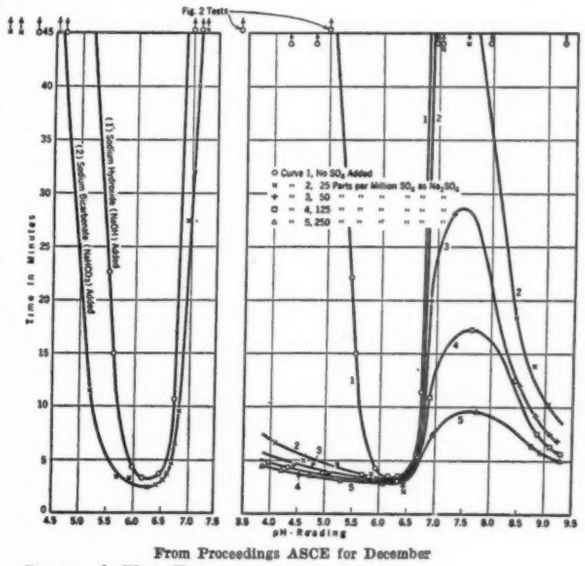
FERRIC COAGULANTS have become available for water purification in adequate quantity and practicable price only within the last three or four years, and much still remains to be learned concerning the chemistry and physics of their action. Bartow, Black and Sansbury have reported the results of a study of the effect on floc formation of pH value and of sulfate, sodium and other ions in the treated water[1].

Soft waters that are colored or turbid may usually be coagulated more satisfactorily on the acid side, and aluminum sulfate serves the purpose. But aluminum hydroxide is amphoteric and its solubility increases as the pH increases. From the acid side, precipitation becomes complete at pH 5.4, and at less than this, alum floc will redissolve. But with many highly colored waters successful clarification may be obtained only at much lower pH values, even 3.8 for swamp waters, at which satisfactory coagulation may be obtained with ferric salts but not with alum. Ferric floc is more insoluble at higher pH values also.

Sulfate and chloride ions, which natural waters contain in varying quantities, are known to exert marked effects on the pH zone of optimum alum floc formation, and the authors, experimenting with ferric salts, report that: "(1) On the acid side the sulfate ion has a much greater effect on coagulation than the chloride ion; (2) using from 25 to 250 ppm. of sulfate ion, there is little change in the effect produced; (3) between a pH value of 6.5 and a pH value of 8.5, there is a zone in which ferric floc forms slowly or not at all; and (4) in and beyond this zone, sodium and calcium ions are most effective in coagulation. . . . The quantity of residual iron in solution is roughly proportional to the time required for the floc to form."

Manganese and iron in even small quantities are very objectionable in pulp, paper, textile and rayon manufacturing.[19] In reservoirs they are usually combined with organic matter, and to oxidize them successfully it is necessary first to remove the organic matter. Paul W. Frisk reports that: "1—Manganese up to 1.0 ppm. in raw water may be removed by double oxidizing agents (chlorine and potassium permanganate), coagulated and precipitated by aluminum sulphate and soda ash. 2—The last traces of iron and manganese may be removed by the catalytic agents of the iron and manganese oxides in the sand (of the filter). 3—There is no apparent effect on the quality of the effluent when the sand bed contains as much as 1.0 per cent of manganese and 0.2 per cent of iron calculated on dry sand. 4—By careful periodic washing with the air rake, it was possible to keep the iron and manganese to approximately 0.5 per cent over a period of five years. 5—Soaking the sand in a solution of 10 per cent caustic soda for 6 to 12 hours dissolves a large part of the iron and manganese oxides, which are readily washed out."

Sludge from water softening present a problem in the ultimate disposal of it which "is still unsolved where it is impossible to discharge it into a stream. At the present cost of lime, it will probably never be found economical to reburn it. Where it is produced in large quantities it will not be found feasible to dispose of any large percentage of it for agricultural purposes."[17] Ponding was adopted for the Mahoning Valley plant, with two ponds, to be used alternately, the partially dried sludge to be removed by drag line from each pond before again going into service. It was calculated that each million gallons of water softened would produce 2,000 lbs. of solids, or about 300 cu. ft. of sludge, which is pumped through 1300 ft. of 4-inch pipe to the ponds. The cost of ponds and pipe line was $9,500. After 10 months' operation, treating an average of 10 mgd, 325,000 cu. ft. of concentrated sludge has collected. Thos. R. Lathrop (quoted above) believes filling low land is the only solution. At Newark, O., which pumps sludge continuously into the river, there is a deposit of sludge banks for a mile or two down stream. Marion, O., ran its sludge (from 1 mgd.) into an abandoned quarry and borrow pit 400 x 75 x 20 ft. deep and filled it in less than a year. Although it is equal to agricultural lime, the amounts are too enormous to hope to dispose of it all in this way. The plant at Miami, Fla., has filled low land surrounding it and, covered with an inch or two of soil, it is excellent for growing grass and vegetables.



From Proceedings ASCE for December

Ratio of Floc Formation by Ferric Sulfate with Hydrogen-Ion Concentration adjusted by: (1) Sodium Hydroxide (NaOH) and (2) Sodium Bicarbonate ($NaHCO_3$)

Effect of SO_4 as Sodium Sulfate (Na_2SO_4) on the Zone of Floc Formation by Ferric Sulfate [$Fe_2(SO_4)_3$] at Varying pH-Values.

A. *water works chemist,* to insure satisfactory plant performance, needs to stress six things:[34] 1—Proper discipline of the plant personnel; 2—Written directions covering routine operations; 3—Necessity of adequate

preparation of water for filtration; 4—Knowledge of the raw water's significant variable; 5—Chlorination control; 6—Adequate laboratory and production records.

In *bacteriological analysis* of water, economizing in labor and expense should not be given preference to scientific accuracy.[13] Bacterial inhibitive agents, particularly dyes, frequently used in media for the sanitary examination of water, reduce the amount of necessary laboratory routine, but tend to reduce the number of isolations of organisms of the coli-aerogenes group. They should be used with care and "only after they have been shown to give results comparable to those obtained with a non-inhibitive medium on the *particular* water supply under consideration." There is no convincing proof "that the less viable strains of the coli-aerogenes group can be disregarded." "The present 'standard' methods are far from perfect and the coli-aerogenes counts or indices obtained by them are, undoubtedly, too low rather than too high. Defects can be remedied only by a more extensive knowledge of the media used, and particularly of the biochemical processes that take place during incubation under a variety of biologic conditions."

Arch dam design should be modified if maximum safety combined with maximum economy is to be secured, is a conclusion reached by Karpov and Templin[2] as a result of a series of tests made on a model of the Calderwood dam constructed of a special rubber-litharge compound, in conjunction with some of the tests made on the dam itself. They conclude that: 1—A design which assumes a non-yielding foundation cannot satisfy the actual conditions and therefore is inadequate. 2—The assumption of straight-line distribution of stress is not in agreement with actual conditions, and a design which is based on such assumption appears to be inadequate. 3—The bending moments in the horizontal arches produce such heavy concentration of stress at some of the vertical construction joints that a design which neglects the influence of such joints and assumes a monolithic structure is inadequate. 4—The circular shape of the conventional arch dam seems to be responsible for the non-uniformity of the horizontal stresses and introduces additional stresses which should be avoided. Presumably this can be accomplished by substituting a shape better fitting the conditions of the particular canyon. 5—A design in which gravity action is neglected and all load is assumed to be taken by arch action results in a considerable and unwarranted increase in thickness of the horizontal arches at the abutments; the computed stress in such designs is radically different from the actual stress. 6—Vertical tension on both faces of the dam seems to be much larger than is usually assumed. The reduction of such stress merits attention.

Biography of Recent Water Works Literature

c, Indicates construction article; *n*, note or short article; *t*, technical article.

Proceedings, American Society of Civil Engineers, December.

1. *t.* Formation of Floc by Ferric Coagulants. By Edward Bartow, A. P. Black and Walter E. Sansbury, pp. 1529-1542.
2. Model of Calderwood Arch Dam. By A. V. Karpov and R. L. Templin, pp. 1565-1599.
3. *t.* Evaporation from Water Surfaces. Discussions by Ivan E. Houk and R. I. Meeker, pp. 1633-1636.
4. *t.* Actual Deflections and Temperatures in a Trial Load Arch Dam. By Ivan E. Hauk, A. V. Karpov and R. L. Templin, pp. 1639-1647.

Contractors and Engineers Monthly, December.

5. *c.* Excavation and Backfill for the Lake Springfield Dam, pp. 26-28.

The Surveyor, November 17.

6. Interconnection of Water Undertakings. By Alan L. Chorlton, p. 465.

December 1

7. Mechanical Filtration of Water, p. 509.

December 8

8. Water Supply of Kano, Northern Nigera. By H. J. F. Gourley, p. 532.
9. Legal Aspect of Water Supply for Fire Protection. By John Hall, p. 539.

Construction Methods, November.

10. *c.* Construction Starts at Norris Dam, p. 15.

December

11. *c.* Concreting Methods Aid Construction of Waterworks Plant, pp. 29-31.
12. c. San Gabriel No. 1 Dam to Contain 5,600,000 yds. of Rock Fill, pp. 34-35.

Journal, American Water Works Association, November.

13. *t.* Current Research in Water Bacteriology. By John F. Norton, pp. 1473-1481.
14. Proposed Plan for Ammonia-Chlorine Treatment in Chicago. By A. E. Gorman and H. H. Gerstein, pp. 1482-1489.
15. *t.* Control of Tastes and Odors in Public Water Supplies. Report of Committee, pp. 1490-1504.
16. *t.* The Removal of Aggressive Carbon Dioxide by Contact Beds of Limestone or Marble. By C. R. Cox, pp. 1505-1522.
17. *t.* Disposal of Sludge at Water Purification and Softening Works of the Mahoning Valley Sanitary District. By W. H. Dittoe, pp. 1523-1533.
18. Filtering Materials. Progress Report of Committee, pp. 1534-1536.
19. *t.* The Control of Iron and Manganese in Filter Sand. By Paul W. Frisk, pp. 1537-1550.
20. *t.* Fundamental Factors Governing the Stream-Line Flow of Water Through Sand. By Gordon M. Fair and Loranus P. Hatch, pp. 1551-1565.
21. Progress in Water Purification. By George W. Fuller, pp. 1566-1576.
22. Industrial Water Purification Research. By Sheppard T. Powell, pp. 1577-1588.
23. The Work of the State Sanitary Engineer. By E. S. Tisdale, pp. 1589-1597.
24. The Public Relations Value of the Water Works Laboratory. By Harry E. Jordan, pp. 1598-1602.
25. *t.* Taste and Odor Control by Physical Adsorption. By F. E. Stuart, pp. 1603-1607.

The U. S. Piper, December.

26. Wanakah Water Company Uses de Lavaud Centrifugal Pipe. By Alfred M. Roberts, pp. 60-61, 69.
27. History of Cast Iron Pipe Line Laid in 1854 at Nashua, N. H. By D. C. Calderwood, pp. 66-68.

The American City, December.

28. New Zeolite Softening Plant at Lancaster, O. pp. 41-44.
29. Fort Wayne Completes New Filtration Plant and Pumping Station. By R. L. McNamee, pp. 47-49.
30. Installing 60-inch Cast Iron Water Main as Part of an Emergency Relief Program, pp. 59-60.

Water Works Engineering, November 29.

31. The Removal of Manganese. By M. J. Davis, pp. 1192-1193.
32. What Is Potable Water? (Ideas of several sanitarians), pp. 1194-1196.
33. Algae Problems. By Ross A. Thuma, pp. 1197-1199.

December 13

34. Peoria's All-Electric Pumping System. By J. J. Garland, pp. 1236-1237.
35. Collection of Delinquent Accounts in Detroit. By Hal F. Smith, pp. 1238-1242.
36. Algae Problems. By Ross A. Thuma, pp. 1243-1244.
37. Reducing Damage to meters from Hot Water. By George Reed, p. 1264.

Engineering News-Record, November 23.

38. Economical Construction for Prechlorination House, p. 625.
39. Copious Artesian Supply Serves Entire Township. By F. J. Keis, pp. 627-628.

December 21

40. Boulder Dam Progress. Eleven articles by Elwood Mead, J. J. Ballard, R. F. Walter, Byram W. Steele, D. C. McConaughy and the editorial staff, pp. 733-763.

Public Works, December.

41. Low-Heat Cement for Dam Construction. p. 12.
42. *t.* Bacterial Efficiency of Certain Intermediate Stages of Water Treatment. By H. W. Streeter, pp. 17-20.
43. Municipal Operation of a Privately Built Water System. By M. E. Linton, pp. 23-24.
44. The Water Wheel, pp. 27-28.

The Canadian Engineer, November 21.

45. Many Municipal Water Works in Ontario Show Profits, p. 10.

December 5

46. Amherstburg Effects Large Saving in Waste Water Survey. By C. G. R. Armstrong, pp. 9-11.
47. Consumption of Chemicals in Municipal Water Works in Canada, p. 13-15.
48. *n.* Waterworks at Marieville, Que. By E. F. Roberts, p. 17.

December 19

49. Protection of Water Supplies on Common Carriers in Canada. By G. H. Ferguson, pp. 9-11.

Stabilizing Michigan Gravel Roads with Clay and Calcium Chloride

By E. E. Blomgren and J. W. Kushing
Maintenance Engineer, and Research and Testing Engineer, Michigan State Highway Department

The first installment of this article, giving detail methods of construction appeared in the December issue.

Summary of Operations

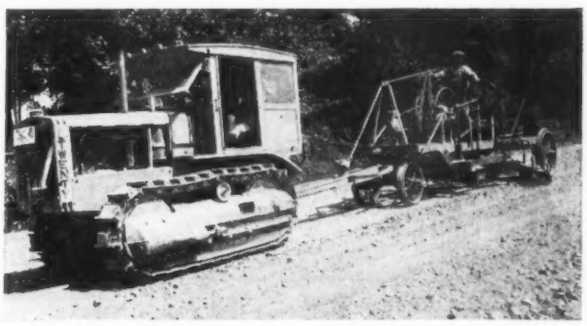
It will be noted from the foregoing paragraphs that the chief steps in the stabilization of a gravel road may be summarized as follows:

1. *Sampling of Materials*—Samples are taken of the road surface and of a number of available clays.
2. *Laboratory Soil Tests*—These aid in the selection of the binder and determine the correct proportioning of the latter to the road material.
3. *Delivery and Preparation of Clay*—In order to fully utilize the binding properties of the clay it is necessary that it be thoroughly dried and pulverized.
4. *Scarifying and Mixing*—After scarifying the road surface, the finely divided clay must be uniformly distributed through the gravel by thorough mixing.
5. *Compacting and Shaping*—The presence of some water is essential for these operations, and if not furnished by rainfall should be applied artificially.
6. *Application of Calcium Chloride*—The road surface should be in a firm, smooth and damp condition when this treatment is made.

Cost Data

The total cost of the project was $2,820.44 for the 7.4 miles stabilized with clay and calcium chloride. This amounted to $381.13 per mile. The actual cost exceeded the estimated expenses somewhat, but this was due chiefly to the unanticipated use of water-spraying to aid in the quick compaction of the road, and to quite thorough removal of oversize stones from the old road material. The extra cost, however, which amounted to about $90 per mile, was well justified. The use of the water permitted immediate compaction and shaping of the mixed road materials so that with the subsequent application of the calcium chloride there resulted a smooth, dustless road. If the water had not been used it would have been impossible to have obtained a satisfactory, finished surface until after one or two rainfalls had occurred. As a matter of fact, a couple of weeks elapsed before sufficient rain fell to provide enough water for final compaction. The complete removal of large stones which amounted to about 96 cubic yards, was worth the extra expenditure since the absence of the oversize material will aid in maintaining a smooth road surface. Table I gives summarized cost data, and Table II shows the detailed expenses.

View and close-up of a finished road



Removal of over-size stone with mechanical rake

Table I—Summarized Construction Costs

Operation	*Unit cost per mile*	*Total cost*
Clay on road	$162.78	$1,204.58
Clay dried, pulverized and spread on road	12.57	93.02
Scarifying	14.11	104.40
Cutting out, mixing and forming	35.31	261.27
Raking and stone picking	37.33	276.30
Blading	10.41	77.00
Water-spraying	25.03	185.23
Calcium chloride, including spreading	59.20	438.10
Moving equipment, gas and oil, torch, and sign labor	24.39	180.54
Totals	$381.13	$2,820.44
Cost per square yard		$0.036

Laboratory Data

Composite samples were taken at each of three stations along the road, both before and after stabilization of the gravel. Each sample was composed of material taken to a depth of 2.5 to 3 inches at each of three points across the road at the station. Sieve analyses and physical soil tests were performed on the various samples, and the data which were obtained are reported in Table III.

It is apparent from the test data that a decided increase in plasticity index is the chief point of difference between the stabilized and unstabilized gravel samples. Originally the road samples each had a plasticity index of zero. After the addition of the clay to the road the

Table II—Itemized Construction Costs

Operation and Distance	*Equipment*	*Time or Quantity*	*Unit Cost*	*Total Cost*
CLAY				
In pit		799 loads**	$0.08	$63.92
Loading by shovel	shovel*	50 hrs.	1.94	97.00
Hauling and dumping	2 yd. dump truck	Av. 6 mi.	10c yd. mi.	985.00
Blading to shoulders	grader*	14 hrs.	1.69	23.66
Supervision of above		140 man hrs.	.25	35.00
Spreading, pulverizing and windrowing	grader*	14.8	1.69	25.01
	Tr. roll harrow*	37 hrs.	1.50	55.50
Spreading for scarif.	grader*	7.4 hrs.	1.69	12.51
SCARIFYING	mechanical rake*	50 hrs.	.795	104.40
	caterpillar*	50 hrs.	.893	
	tractor*	16 hrs.	1.25	
CUTTING OUT	grader*	66 hrs.	1.69	
MIXING AND	caterpillar*	78 hrs.	.893	261.27
FORMING	grader*	77 hrs.	1.04	
RAKING AND STONE	tractor and rake			
REMOVAL	2—2 ton trucks and rakes 8 laborers			276.30
WATER SPRAYING	tank truck*	41.5	4.463	185.23
BLADING (ALL)	Int. Truck*	56 hrs.	1.375	77.00
CALCIUM CHLORIDE		20 tons	19.50	390.00
CALCIUM CHLORIDE SPREADING	2 trucks* 2 extra men	26 hrs.	1.85	48.10
MOVING EQUIPMENT				23.90
GAS AND OIL				129.54
TORCH AND SIGN LABOR				27.10
		TOTAL COST		$2,820.44
		Average cost per mile		$381.13
		Average cost per square yard		$0.036

*Including operator.
**1½ to 2 cu. yds. per load.

Table III—Laboratory Reports

Description of Project
M—36 Ingham County, Michigan, from east city limits of Dansville to concrete pavement at Mason. 7.4 miles.

Description of Sample	*Mechanical Analysis, Percentage by weight* — *Gravel* — *On 1 inch*	*Pass 1 inch on ½ inch*	*Pass ½ inch on No. 10*	*Soil* — *Fines* — *Coarse Sand* Pass No. 10; on No. 40*	*Fine Sand Pass No. 40; on No. 270*	*Silt*	*Clay*	*Physical Test* — *Liquid Limit*	*Plasticity Index*
Station 1—Before stabilization	4	5	39	24	17	6	5	15	0
Station 1—After stabilization**	0	4	37	21	21	8	9	18	6
Station 2—Before stabilization	11	5	32	21	20	5	6	15	0
Station 2—After stabilization	2	6	33	19	23	7	10	20	8
Station 3—Before stabilization	0	5	31	26	25	7	6	15	0
Station 3—After stabilization**	0	8	34	20	20	8	10	19	7
Loose material at Station 1, Before stabilization	1	3	52	30	11	2	1	—	—
Clay—Sec. 28 Wheatfield Twp.	0	0	4	4	26	20	46	41	23

*For practical purposes, coarse sand is considered as passing No. 10 and retained on No. 40 sieve.
**Samples taken approximately two months after stabilization work had been completed.

average plasticity index of the top two and one-half inches was seven. This indicates a material increase in the cohesive or binding power of the soil fines which were present in the gravel.

Maintenance

After one or two rains and subsequent scraping, the surface on all sections of the road was hard, dustless, smooth, and free from loose material.

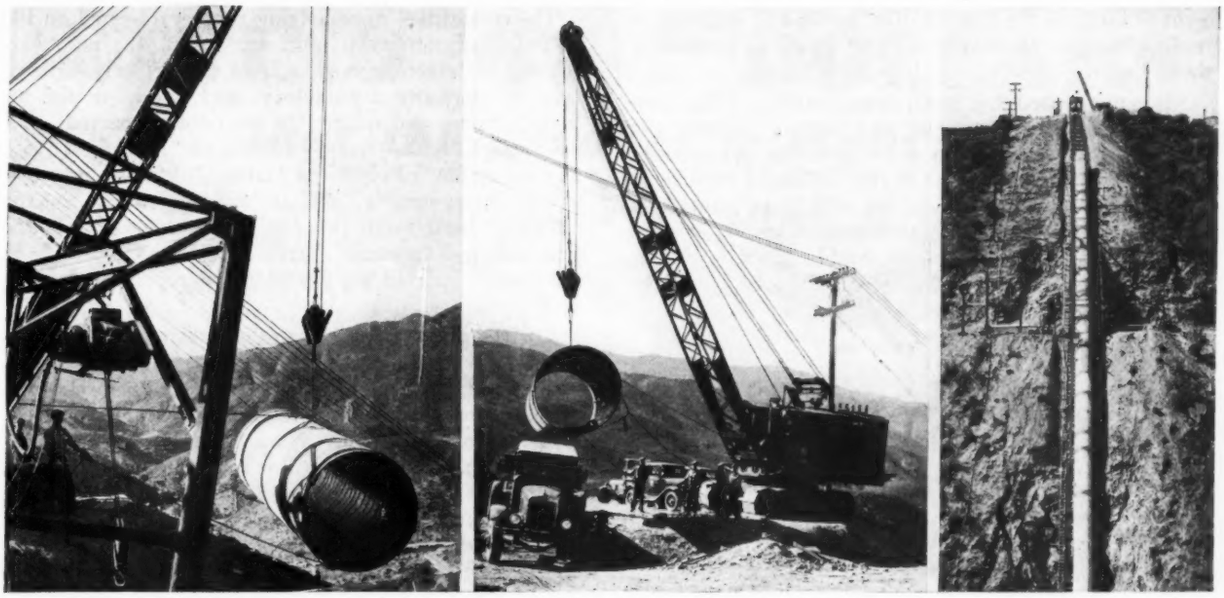
Due to the hardness of the surface, scraping has not been necessary or possible except following wet periods. Rainfall sufficient to permit reshaping has occurred only five times in the two months since the project was finished. During dry spells of two to three weeks the surface remained smooth.

Results obtained to date on this and other projects indicate that this type of surface makes possible a decided saving on the maintenance of gravel roads, the items that are reduced being scraping costs and gravel replacement expenses.

Tar Research by University of Pittsburgh

The University of Pittsburgh announces that "what is said to be the first exclusive road tar research program undertaken by any American university has just been started at the University of Pittsburgh in cooperation with the Koppers Products Company. The work is under the direction of Prof. Adelbert Diefendorf, associate professor of civil engineering, head of the department of highway engineering at the university. Associated with him in the work are E. O. Rhodes, director of the technical department of the Koppers Products Company, and J. H. Swanberg, research associate of Mr. Rhodes."

In preparation for the work, the University has acquired a complete laboratory for the analysis of bituminous highway materials and the determination of strength, durability, and other characteristics of the finished pavement. It contains a large number of testing devices built especially for tests on tar materials.



Crane shifting 12-ton pipe from truck which brought it to "straddle bug" Extreme Right, "Straddle bug" on top of hill ready to carry pipe to place. Los Angeles project.

Large Welded Pipe Line for Los Angeles

As a part of its Owens Valley project, Los Angeles is constructing what is believed to be the largest welded pipe line in the West. This line will connect Bouquet Canyon reservoir with the Owens Valley aqueduct near Saugus, Calif. Its length is about 4½ miles and the size varies from 7 ft. 10 in. to 6 ft. 8 in. As it crosses mountains and canyons, the pressure and necessary strength vary, the maximum pressure being about 400 lbs. per square inch and the thickness of the steel here 1-1/16 inch.

The pipe is fabricated by the Western Pipe & Steel Co. It is being laid and the field welding done by the Los Angeles Department of Water and Power, using "Fleetweld" electrodes manufactured by the Lincoln Electric Co. The welding of each joint requires 450 pounds of electrode, and 32 man-hours of labor for the outside weld and 24 man-hours for the inside. Welding is being carried on 24 hours every day, employing three 8-hour shifts.

Not the least difficult feature of the job is the transportation and placing of the pipe, some lengths of which weigh 12 tons, since the country traversed is extremely rough and roads few, and the sides of the canyons very steep. The method of placing the pipe up a canyon wall is shown by the illustration. A line of rails is laid along each side of the pipe location, on these runs a "straddle bug"—a steel frame which carries the pipe and lowers it into position in its concrete saddles. The pipe is hauled by trucks to the top of the mountain, and there is transferred to the straddle bug by means of a Link-Belt crane (using the two cranes which built the roads leading to and around the Bouquet Canyon dam). The straddle bug then is lowered down the track, carrying the length of pipe suspended from air hoists, the maximum distance lowered being more than 1,000 feet. Using the two cranes, the laying is being carried on up both walls of the canyon.

Water Purification in South Africa Compared With American Practice

"In comparing South African water supplies with those of Great Britain, there are not many parallel conditions," said Walter M. Campbell, borough water engineer for Durban, in a paper before the South African District of the Institute of Municipal and County Engineers, but "one finds that American current practice provides more fitting guidance in solving some of our problems, such as those that arise in dealing with turbidity ranging from the gross to the colloidal."

Rapid Sand Fillers

Such turbidities are virtually unknown in England, which explains why slow sand filters prevail rather than rapid, the English authorities believing that the former give water that is safer bacteriologically. But "where formerly the slow sand system afforded a higher percentage removal of bacteria under proper care than the various rapid mechanical systems, the after use of chlorine has levelled up that discrepancy, and with the more economical capital outlay in the case of the latter there has been considerable headway made in the adoption of mechanical filters during the last twenty years."

However, Mr. Campbell believes that the rapid filters have difficulties, such as sand analysis and methods of cleaning, from which the slow sand filters are free, and he "definitely finds that slow sand filters remove algae odors and tastes although mechanical filters do not. . . . Rectification by a sequence of chemical reactions means unending trouble, especially where, as in many cases, there is frequent and rapid variation in the chemical and physical characteristics of the raw water. The very recent adoption of activated carbon for rectification of filtered water in hundreds of filtration stations in Europe and America to aid the rapid filter to fulfill its functions is of considerable significance, in itself indicating the urgent need of some radical remedy for its shortcomings. We are only on the threshold of investigations in this direction, which may lead to a good deal of adjust-

ment of ideas on the comparative merits and economy of rapid filters as against slow sand filters in producing water that is not only pure, but also palatable.

"It is not denied that rapid filters do effect a high percentage clearance of germs and organic matter, and perforce their adoption in many cases is unavoidable, but it would appear from a survey of world experience that their proper place in future will be as primary or roughing filters preceding slow sand filtration or some other refining process." Such double filtration is employed with excellent results for treating the water supply of London from a highly contaminated source.

Activated Carbon

"The use of activated carbon may, however, revolutionize our practice in final purification, and a field of experience has now been opened up that will be well worth studying by South African engineers, as it already promises favorably in American practice in dealing with color, taste and odor troubles." In Durban, experiments are being made with carbon both in the pulverized form and as a filter medium. Experiments began in 1927 with wood charcoal, and later ones with activated carbon "at least warrant their continuance."

It has been proved that "thorough admixture of the coagulant with the raw water is of the essence of efficient sedimentation and of late years the use of mechanical floculators has been gaining ground."

Aeration by fine diffusion has been found very effective in Durban for restoring oxygen to water that has been a long time in storage, as well as for removing tastes and odors, and carbon dioxide.

Centrifugally Cast Iron Pipe

Centrifugally cast iron pipe is imported into South Africa and, now that satisfactory annealing is possible, the percentage of damaged pipes coming by sea is certainly no greater than it used to be with the ordinary sand-cast pipe, and failures under pressure in the trench are definitely less. Experience with this pipe since 1923 has shown it to be more homogeneous, have fewer flaws, less tuberculation and incrustation; while its greater tensile strength permits a saving in weight.

Taste and Odor Control by Activated Carbon

THE Committee on Control of Tastes and Odors of the American Water Works Association reported in 1933 that, of nine methods used for exercising such control, as reported from twelve states active in such treatment, powdered activated carbon was used by 34.6 percent of the supplies, and granular activated carbon used as a filter medium by 0.6 percent; while exactly the same number used the ammonia-chlorine method. Pre-chlorination was used by 25.9 percent, and only one other process—super and dechlorination—was used by more than one percent. Powdered carbon was used by 23 plants in Pennsylvania, 20 in New York, 18 in North Carolina, 16 in Ohio, 8 in Iowa, 7 in Georgia, 6 in Missouri, 5 in South Carolina and in Indiana, 3 in Florida, and 2 in Alabama and in Minnesota. Granular activated carbon was used in one plant in New York and one in Ohio.

The committee reports that "Powdered activated carbon, either alone or in conjunction with other methods used for taste and odor control, is, in the minds of many operators, the most universally applicable taste and odor control measure now available."

The committee, summarising replies returned on 141 of the questionnaires it sent out, found 121 plants reporting satisfactory results from use of activated carbon, 15 partially satisfactory, and 5 that it did not correct tastes and odors. Of the odors reported, 17% were described as "fishy," 15½% as "earthy," 13½% as "vegetable," 11½% as "musty," 9% as "grassy," 9% as "disagreeable," 6% as "mouldy," 5½% as "free chlorine," and small percentages as "peaty," "hydrogen sulfide," "phenol," "aromatic," etc. Only 21% of the plants reported but one odor, two reporting as many as 8 odors.

Of 219 plants replying to the question, 109 applied the carbon in the coagulation process and 110 on top or just ahead of the filters. Of the former, 66 reported the additional advantage of getting better coagulation with carbon than with alum alone, and 35 use less coagulant; 40 get longer filter runs; 76 get more stable sludge. Of the plants applying carbon just ahead of or on the filters, 23 reported getting shorter filter runs, 34 that they did not (53 not replying). Dry feed was reported by 70 plants, solution type feed by 65, and 60 mixed the carbon with routine chemicals. As to carbon dosage, 23% average 1 to 5 pounds per million gallons, 30% 6 to 10 pounds, 16% 11 to 15 pounds, 12% 16 to 20 pounds, 10% 21 to 30 pounds, and the remainder from 31 to 110 pounds.

The procedure of using activated carbon has been developed to more satisfactorily meet the various conditions found, the experiences of the hundreds of plants using it having been compared and studied during the past two or three years. At the same convention of the A. W. W. A., F. E. Stuart, research engineer of the Industrial Chemical Sales Co., outlined what is probably the most satisfactory for usual conditions. Briefly stated, this is as follows:

When a severe taste develops, immediately apply a concentrated aqueous solution of carbon—about 2 pounds per m.g. filter capacity—evenly distributed on the beds. Then apply 16 pounds per m.g. directly to the filter influent, by dry feed or solution tank. At the same time or immediately after, blanket the sludge in the coagulation basins by several intermittent dosages of carbon applied directly to the mixing chamber, using a total of about 25 lbs. per m.g. of water treated per day. During this initial preparation it is advisable also to be sure there is adequate coagulation, increasing the coagulant dose in some cases. Additional carbon should now be introduced regularly into the mixing chamber, either separately or mixed with the routine chemical; about one part per m.g. or, if mixed with alum, 4 lbs. of carbon to 96 lbs. of dry alum is advised.

This initial preparation will probably result in shorter filter runs, but as soon as the taste has been materially reduced the procedure can be changed and the filter runs will return to normal or nearly so. The application of carbon directly to the filter influent is discontinued, and that at the point of coagulation increased to approximately 16 lbs. per m.g. (to be adjusted by trial to the optimum rate). However, the carbon should not be retained more than 8 hours before reaching the filter, which may necessitate moving the point of application nearer the filter.

In adjusting the dose of carbon to the optimum rate, closer control can be obtained by using separate dry feed equipment than by mixing with the routine chemical. After the taste epidemic has passed it is advisable to continue to feed 4 lbs. per m.g. to the mixing chamber to maintain the precipitated coagulant in a stable condition.

See pages 51-53 for descriptions of helpful booklets.

Chlorine For Small Sewers

Abstract of paper before Missouri Water and Sewerage Conference

By G. S. Robins, President, G. S. Robins & Co.

THIS paper is presented to point out the simplicity with which small sewers may be treated with chlorine as a basis of experiment for permanent installations. In many towns, obnoxious sewer odors are being endured because the additional tax burden necessary for equipment is too great a gamble without assurance and demonstration of its effectiveness. This paper describes a test of chlorine made at Webster Groves, Mo., a city of about 18,000 population, in which a convenient method of feeding sodium hypochlorite was installed preliminary to obtaining regular chlorine equipment.

Old septic tanks had been inoperative for several years, but as a central sewerage system for all St. Louis county was proposed, no cities in the area were spending money on permanent installations. But as the dilution of Webster Grove's sewage in the River Des Peres during three dry summers had been totally insufficient to prevent nuisance, chlorine treatment was tried; but it was desired first to test its effectiveness with the minimum expenditure.

Laboratory tests indicated that chlorine in sodium hypochlorite solution at the rate of 35 ppm eliminated the odor (principally hydrogen sulphide) and bleached the color more than 75%, but less did not do so. The city engineer, John Clayton, found the maximum flow at the three outlets to be 5,400 gph, 5,940 and 10,800 respectively. It was found that a solution of sodium hypochlorite, well stabilized and containing 12% chlorine, could be obtained in 5-gallon glass carboys, and this was used rather than installing concrete or wooden mixing tanks for use of H T H or chloride of lime or liquid chlorine equipment.

To use them, each 5-gal. carboy was fitted with a rubber stopper through which two holes were bored, through one of which a ⅜" glass tube was inserted extending to within 1/16" of the bottom of the carboy to serve as a vent, while a short glass tube was inserted in the other hole to the bottom of the rubber stopper and extending 3" above the top of the stopper and over it was fitted a section of ¼" tubing long enough to reach the desired point in the sewer. The carboy was then turned upside down and rested in a wooden crate at an angle of about 60°. A pinch cock applied to the rubber tubing regulated the flow. Two drops per second gave a flow of ½ gal. per hour, and as the solution was standardized at 12% chlorine by weight, it was easy to deliver it at the desired rate.

While the laboratory test indicated 35 ppm necessary for the maximum pollution, experiments were started using 9 ppm. This required putting in place a 5-gal. carboy at each station twice a day, but this was more convenient than handling larger ones, as it could be handled by one man, was standard water bottle size and could be replaced for $1.00 if broken. Complaints of odors from the river were numerous in June, but Mr. Clayton observed that there were many stagnant pools in the stream bed which the chlorine did not reach. Accordingly a channel was dug the entire length of the stream bed draining all these pools; following which, with the chlorine cut to 5 ppm, the odor was less than before with 9 ppm.

Other smaller outlets were treated with satisfactory results using a 5-gal. carboy every two days. Several private sewers serving four or five houses each were treated by dumping an excess quantity of chloride of lime into the outlet ditches at intervals during the season, which was gradually dissolved by the small flow of sewage.

Where a sufficient quantity of chlorine is needed, it would be more economical to introduce the chlorine in the form of slurry of H T H or chloride of lime. Dry chloride of lime containing 35% available chlorine, in 30 lb. drums, costs from $3.00 to $3.25 per hundred pounds or approximately 9 cts to 9¾ cts per pound of chlorine. Anhydrous chlorine gas in cylinders in Missouri costs 9 cts. per pound. Where the flow of the sewer is sufficient to disperse the dry chloride of lime powder it is not necessary to make the slurry, since dry feed machines are available for regulating the flow of dry chloride of lime. Where the volume of chlorine used justifies the purchase of liquid chlorine in larger quantities at considerable less cost, the use of this and the installation of regulation equipment would be the most economical method.

Motor-Vehicle Taxes Fairly Apportioned

The highway service used by urban and rural motor vehicles is about in proportion to the motor-vehicle imposts paid in Wisconsin, Michigan, and Illinois, according to a study of highway taxes and road use made by the Federal Bureau of Public Roads.

To lay down a broad basis for the adjustment of highway taxes on a rational plan, the Bureau studied the highway finances of Wisconsin, Michigan, and Illinois for the calendar year 1930, the latest year for which full records were available, to determine the highway taxes paid from different sources and by different groups of citizens, based on local administrative units and the highway service furnished.

It was found that rural property in these States paid no tax for urban streets, but a part of the tax on urban property was expended on local township roads.

Rural motor-vehicle owners in Wisconsin paid 33.9 percent of the total motor-vehicle imposts expended on all classes of roads and streets, and travel by these same rural motor-vehicle owners made up 31.9 percent of the total travel on all classes of roads and streets. City and village motor-vehicle owners paid 66.1 percent of the taxes and did 68.1 percent of the traveling on the roads and streets. A similar situation was found in the other two States.

Treating Icy Pavements

The Maintenance Committee of the Highway Research Board of the National Research Council, reporting to the annual meeting December 8th, presented recommendations for treatment of icy pavements which are substantiated by the results of an extensive series of tests, as well as by a study of prevailing practices in those states where inclement weather conditions prevail.

For the treatment of state highway systems the committee recommends the application of calcium chloride treated sand or cinders applied at the rate of two pounds per square yard of pavement surface; where it is necessary to remove the ice, as in the case of city pavements, the committee recommends the application of two pounds of calcium chloride per square yard of surface, and states that the resulting slush should be removed as soon as practicable.

See pages 51-53 for descriptions of helpful booklets.

Old Brick + CWA Labor = Good-as-New Pavement

By Q. A. Campbell
Assistant Chief Engineer, National Paving Brick Association

Columbia, Mo., brick pavement relaid after twenty years on old concrete base at cost of 63.2 cents per square yard, 68 percent of the old brick being salvaged. Photograph taken before rolling

RELAYING brick from old pavements has been proposed by many municipalities as work to be performed under the CWA program, and been approved as such. It would seem to be especially suitable for such a program, for it gives a maximum of employment to hand labor directly on the job, with a minimum expenditure for material and for purchase or rental of equipment; and can be done in individual jobs of any desired size without sacrificing economy.

The results obtained by relaying brick have been proven satisfactory in many localities. Many old brick streets in American cities today are unsatisfactory only because they are not smooth when judged by present-day standards of construction, having been laid in the "ox-cart" days on foundations inadequate for the great increase in weight, speed and amount of traffic that has developed. They are still in existence only because the brick units themselves have survived the wear of traffic as well as the effects of time and the elements.

The bricks in such a pavement can be removed, cleaned and piled along the curb; the base then repaired and brought to a proper crown by a leveling course; a thin bedding course of clean sand or mastic applied; and the brick relaid.

Cleaning of the brick is usually done by hand. It is inevitable that some should be broken in cleaning, while others are broken in removing and handling, but the loss of brick usually runs less than 20 percent. The bricks are relaid with the unworn surface up and the joints filled with asphalt or cement grout in the same way as when new bricks are used, the resulting pavement being practically the same in appearance and quality as a new brick pavement.

In preparing to relay a brick pavement, the question always arises as to whether the old base will be satisfactory for the new surface. It has generally been brought to a stabilized condition by the action of traffic and weather during the many years of its life, and any failures due to slab weakness or subgrade conditions have usually been corrected, and there is therefore reason to believe that it is more reliable than a new base course on a new subgrade. Additional curb and widening usually accompany brick resurfacing, and this affords opportunity for structural reinforcing of the old base if this is considered necessary. Of course, the replacement with new material of completely disintegrated sections is a part of the reconstruction procedure.

If the old base is concrete, there are different methods of correcting irregularities in it, and different types of cushion; the choice of the former being dependent to to some extent upon that of the latter. If a plain sand cushion is used, the base should be brought to a true cross-section, since the cushion should not vary in thickness. But if the cushion be of granulated slag (which has cementing properties), of sand-cement, or bituminous mastic, a variation of ¾ inch to 1½ inches is usually permitted in the surface of the base. Greater irregularities should be corrected, and for this purpose a sand-cement mortar proportioned 1:3 is commonly specified. Bituminous concrete also has been used. These are to fill depressions only and not to add structural strength. Being confined under the cushion proper and between the curbs, there is little opportunity for displacement even if cracking occurs.

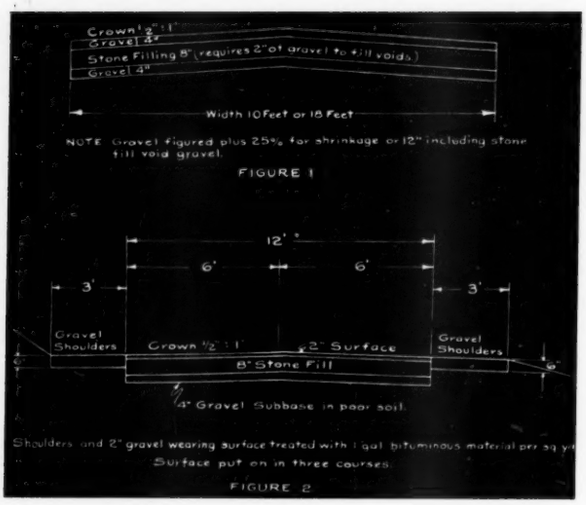
According to tests and studies of the U. S. Bureau of Public Roads (as reported in Public Roads Magazine, September, 1926) a bedding course of plain sand is to be preferred to one of cement-sand. This would indicate that a flexible type of cushion such as bituminous mastic is desirable. The development and extensive use of the bituminous mastic cushion has been coincident with the brick resurfacing program in Illinois. In sections of the country where granulated blast furnace slag is not economically available, mastic cushion is recommended for all brick paving construction. It is stable but resilient, will not sift down into small cracks, has waterproofing qualities and would seem to be especially applicable to brick resurfacing construction.

Relaying brick not only offers the opportunity of giving labor to considerable numbers of men, but has a direct financial advantage in that it obviates the necessity of purchasing more than a small part of the brick needed for repaving, the salvage value of the reclaimed brick sometimes even exceeding its original cost because of increase in price since its purchase.

Filling Mud Holes on Farm-to-Market Highways as a CWA Project

By L. O. Marden
Worcester County Engineer

WITH a view to making use of CWA funds, the Worcester County Commissioners, acting through Harry A. Cooke, chairman of the Board of County Commissioners and County Federal CWA administrator, decided, after investigating several feasible projects, that filling the mudholes on farm-to-market roads was the project which would put 1,500 men



Sections of pavement used on farm-to-market roads by Worcester Co., Mass.

to work in the shortest possible time. They had at hand a detailed report on the location and length of mud holes on county and town roads in fifty-seven towns of the county, which report enabled them to obtain $226,000 of CWA funds from the Federal Government for this project. Authorization to start the project was granted Thursday evening, December seventh, and by the following Monday the allotments had been made for the projects in the fifty-seven towns, the organization perfected, and 1200 men had started work, and by December sixteenth the remaining 300 men were at work on these projects.

Method of Handling Work. The county has been subdivided into six districts, each district being composed of a group of towns. Each district has a supervisor, or general foreman, who supervises the town highway superintendents in charge of the CWA projects in the various towns. The supervisors report the progress of their work to the county CWA office in Worcester. The Worcester county engineering department is furnishing the necessary grades and stakes, and inspecting the progress of this work where needed.

Type of Road Constructed. Figure one shows the type of pavement being constructed in this mud hole elimination. The road consists of a stone filling 10 or 20 feet wide, compacted by rolling to a thickness of 8 inches. This filling is composed of field stones that do not exceed 10 inches in their longest dimensions, with about 50 per cent of the stones 5 or more inches in their longest dimension. The stone filling is laid on a 4-inch gravel sub base. To fill the interstices in the stone filling, a layer of about 2 inches of loose gravel is spread and rolled.

A 4-inch wearing surface of gravel is then spread and rolled. Gravel shoulders and a bituminous wearing surface can be added at some future time, or after the road has been extended to form a continuous pavement to join with a secondary road. The report on mud holes and the costs of constructing the stone filling were furnished by J. A. Johnston, District Engineer of the Massachusetts Department of Public Works.

Wearing Qualities of This Type of Pavement. Figure two shows a very similar section of this type of farm-to-market road constructed during the last two or three years on several projects in Worcester county, which has given very satisfactory service. This width of stone filling for farm-to-market roads was developed by the Worcester County Commissioners. The average cost of this type of road is around $9,500 per mile.

The cost of this improvement per lineal foot was estimated to be as follows:

		10 Feet Wide		18 Feet Wide	
Item	Price	Quantity Cu. Yards	Cost	Quantity Cu. Yards	Cost
Earth Excavation	$1.00	0.49382	$0.49383	0.88889	$0.88889
Stone Filling	1.65	0.24691	0.40740	0.44444	0.73333
Gravel	1.50	0.37037	0.55555	0.66666	1.00000
Cost per Lineal Foot			$1,.45678		$2.62222

Speed Record in Winter Construction of Concrete Road

Working 320 men in three shifts, under floodlights and murky globes at night, W. W. Boxley & Company of Roanoke, Va., is aiming at a speed record in constructing for the Tennessee Valley Authority a 4.8 mile heavy-duty highway from Coal creek, Tennessee, to the west abutment of Norris dam on the Clinch river. Cutting their way through rocky, mountainous territory, men with steam shovels and trucks have been breaking the stillness of the Anderson county hills seven days per week since November 5, when the job got under way. It is to be finished within 69 days after execution of the contract.

When completed, the highway will connect the TVA railhead at Coal creek with the dam site. Over it the heavy machinery and materials to be used in constructing the dam will be hauled. The road, therefore, will be 22 feet wide and eight inches thick. Although started only about five weeks ago, grading of the highway is approximately 65 per cent complete and 6,000 feet of 11-foot wide paving has been laid. Ordinarily the grading of 4.8 miles of such a mountainous route would require six months, due to the large number of deep cuts and fills to be made. Heavy excavations on the new highway are numerous, but of the 190,000 cubic yards of earth and rock to be moved 125,000 yards already have been handled. In addition, approximately one-half the 550 cubic yards of concrete to be used in culverts has been laid. Presently at work on the job are 320 men, one paving machine, six shovels,

25 trucks, six steamrollers, eight tractors and bulldozers, and two graders. Concrete already laid is being protected from freezing by the use of canvas frames under which lighted lanterns are placed at intervals.

The Scraper, Dec. 22.

Traffic Counts, 1892 and 1933, on a Massachusetts Highway

The following figures show the traffic at a point in Revere, Massachusetts, on Broadway at Revere St. This road is the main route between Revere and Lynn and carries much of the commercial traffic. Until 1913, when the so-called Revere Traffic Road was built, this road carried nearly all the traffic between Boston and Lynn and points north. It is known as the Salem turnpike.

It will be noted that while, in the days of horse-drawn vehicles, pleasure carriages constituted about 20 per cent of the traffic, last year pleasure cars constituted 90 per cent of the total on week days and practically 99 per cent on Sunday.

1892		
Count based on three days observation.		
Average number of vehicles per day:		
Pleasure carriages	99	
Express wagons	288	
Heavy wagons	107	
Total		484
1927		
Count based on one week observation.		
Daily average for 14-hour day:		
Motor vehicles	8,694	
1930		
Count based on 16-hour day.		
Pleasure cars	12,000	
Commercial vehicles	1,376	
Total		13,376

1933 August count. Based on 16-hour day.	Wednesday	Sunday
Pleasure cars	13,632	24,082
Commercial vehicles	1,363	
Totals	15,146	24,082*

*Very few commercial vehicles.

Getting Equipment Ready for Spring

(Continued from page 8)

Littleford Bros. give the following directions for renewing asphalt heaters:

Thoroughly clean inside tank, carefully removing all choked bitumen. Clean draw-off cock and be sure that it is in working condition; replace, if necessary.

If it is a coal-burning kettle, replace all burned out grates, fire-doors or stacks.

If you have an oil-burning kettle, be sure to inspect the oil burner. Sometimes a new coil or a new burner tip will pep up the burner wonderfully. Clean strainer in burner valve. Completely drain and clean fuel tank. See that filler cap and other fittings are airtight. Clean and oil hand pressure pump; renew cup washer and check valve. Clean and grease wheel bearings and spring shackles.

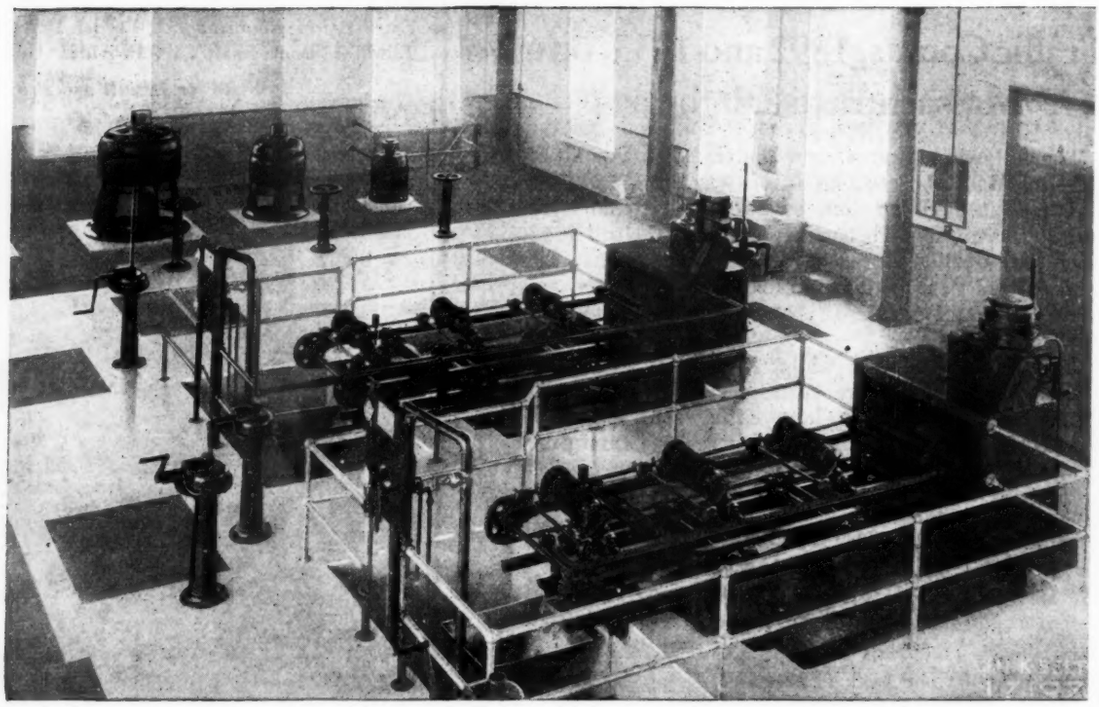
Forms

Straight-edge all forms. (Standard tolerance is ⅛ inch in 10 feet on top and ¼ inch horizontally.) Clean and oil. See that there are enough stakes and wedges and joint plates in serviceable condition.

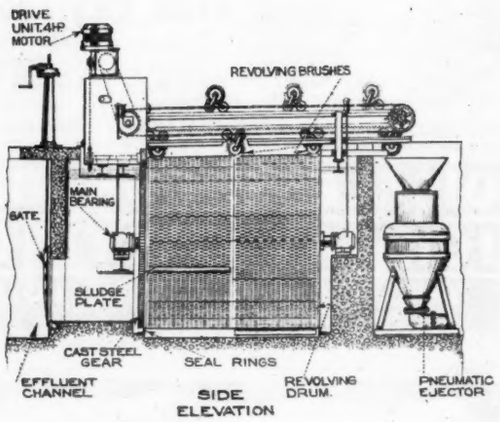
Further information on this important subject will appear in an early issue.

The Tark Sewage Screen

(PATENTED)



For the Clarification of Industrial and Municipal Sewage



In many systems of sewage disposal, fine screens play an important part. They are used in municipal and industrial plants to clarify the sewage before chlorination, aeration, sedimentation, or whatever may be the subsequent treatment of the clear effluent. Used in advance of two-story tanks, they remove the solids most detrimental to sludge digestion, and they form a unit in the preliminary treatment of the sewage in Activated Sludge Plants.

The Tark Screen consists of a drum-shaped screen, automatic sludge reclaiming plates, and a battery of brushes which sweep the sludge from the surface of the screen.

Highly efficient in the removal of suspended solids, economical in operation and upkeep, it is also low in first cost. Send for Catalog No. 642.

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See pages 51-53 for descriptions of helpful booklets.

Cost of Garbage Incineration in Winston-Salem

Winston-Salem, N. C., in February, 1931, placed in operation an incinerator having a rated capacity of 500 tons of garbage in 24 hours, which was built by the Nye Odorless Incinerator Co. This city's fiscal year ends on June 30th, and the record for the two fiscal years 1931-'32 and 1932-'33 are given below.

All garbage is weighed accurately on Fairbanks platform scales immediately before entering the plant, and all ash from the ash tower is weighed after incineration. The plant is operated one 9-hour shift a day except during July, August and September, when a night shift also is used. The regular force was the same during both years: Plant foreman, weighmaster and charger, charger, and 7 stokers.

The cost of fuel was much less in the latter year, as the former was an unusually wet one and the wood used cost $4 a cord delivered, or $800; while the fuel for the latter year was cut by unemployed relief forces and cost only $406.37.

The salaries and wages were as follows:

	1931-'32	1932-'33
Plant foreman	$32.40 per week	$29.16 per week
Weighmaster & charger	18.00 per week	16.20 per week
Charger	15.60 per week	14.00 per week
Stokers	13.50 per week	9.72 per week

Amount of garbage burned, 19,130 tons in 1931-'32; 18,717 tons in 1932-'33.

***Cost of Operation*, 1931-32 *and* 1932-33**

Cost Subdivisions	*1931-32* Cost per ton, cents	*1932-33* Cost	*1932-33* Cost per ton, cents
Administration (Sup't half time)	4.118	$ 702.00	3.751
Labor	41.617	6,974.81	37.265
Fuel	8.541	406.37	2.171
Power and light	3.531	504.23	2.695
Tools and wheelbarrows	0.933	77.50	.414
Ash removal	1.475		
Supplies (water, oil, grease, etc.)	1.376	377.16	2.015
Telephone and insurance	1.245	88.68	*.474
Ground maintenance	0.430	42.49	.228
Repairs to building	0.735	72.98	.390
Repairs to furnace	0.277	108.26	.578
Repairs to mechanical equipment	0.237	49.20	.263
Miscellaneous	0.077	36.83	.196
Total	64.592	9,440.51	50.440
Aver. tons incin. per day of 9 hrs.	69.35		65.85
Max. tons incin. per day of 9 hrs.	117.50		100.00
Min. tons incin. per day of 9 hrs.	44.60		44.30

* Does not include insurance

Sioux City Reduces Refuse Disposal Expenses

For collecting and disposing of garbage, rubbish, ashes and dead animals in the 1932-1933 fiscal year, Sioux City, Ia., paid out $48,993, as compared to $50,485 in the previous year. This reduction was made in spite of an increase in amount of material handled, the cost per ton having fallen from $1.885 to $1.69, or over 10%; and the cost per capita from 63 cents to 61¼ cents, or nearly 3% (assuming an unchanged population of 80,000). All refuse is disposed of on dumps, but an incinerator will be needed before many years.

The expenses comprised $47,162 pay roll, $158.78 for gas and oil, $262.27 for auto expenses, $31.80 for supplies, and $1,378 miscellaneous. There were collected 8,757 tons of garbage and 20,251 tons of rubbish and ashes from a city area of 46 square miles.

For nine years there have been no additions to the department; but Superintendent W. H. Carrigg "hopes that some day we will have funds enough in the department to purchase a small truck to collect the rubbish occasionally from the districts where they feed chickens and keep a cow or a couple of pigs," where the home owners pay city taxes. "The increased number of loads collected by this department," said Mr. Carrigg, "demonstrates that our people have been well fed and also warmly housed even though employment has been below normal."

Cleveland Contracts for Incinerator

Cleveland, Ohio, on September 25th awarded a contract for construction of a refuse incinerator which will consist of six furnaces, each with a rated daily capacity of 150 tons, sufficient to dispose of all its collected garbage and rubbish. The furnaces are of the Sterling, high temperature, mutual assistance, brick type, embodying the latest improvements in construction and equipment. They are to be built by the C. O. Bartlett & Snow Co., and to be completed by July 1, 1934. The cost, including land, will approximate $800,000.

The six furnaces will be placed at right angles to the storage bin, into which the trucks discharge the collected material, and from which the refuse is removed and charged into the furnaces by three overhead cranes equipped with grab buckets of 2 yards capacity. The rate of feed is determined by the stoker through control of mechanical charging machines operated by compressed air. The storage bin is at grade and therefore of easy access, and there is ample space provided on the receiving floor.

The furnaces are arranged in pairs, each having four grates, and being equipped for the supply of preheated air by forced draft. The cinder residue is removed from the grates by means of dumping sections discharging into ash hoppers directly beneath. These hoppers are equipped with mechanically operable gates, by means of which the residue can be loaded directly into trucks for removal from the plant.

There are three chimneys, each 175 feet in height and with an inside diameter of 10 feet, of radial brick construction, lined for the entire height with firebrick in a self-supporting column.

This plant will be larger than any incineration plant yet built in the United States or Canada, and exhaustive study was made to make sure of the economy which it was claimed would be produced by one large centrally located plant as compared to a number of smaller plants to be located in various parts of the city, with the shorter hauls. These studies also had relation to the problems involved in delivery so as to insure against congestion of loaded collection vehicles in the thoroughfares of the city as they approached the plant.

It was estimated that the savings in capital expenditure and in operating charges in one large plant, as against the multiple plant scheme, more than off-set any possible savings through the lessening of haul; and by a happy selection of site for this large plant, the possibility of congestion was avoided, as the approach thereto can be made over seven thoroughfares which, with their inter-connections, permit of easy access from every part of the city.

News of the Engineering Field

Barstow & LeFeber, Inc., has been organized from the former firm of consulting engineers of Barstow & McCurdy, Inc. The address of Barstow & LeFeber is 31 No. Summit St., Akron, and they specialize in water, sewage, stream pollution, operation and laboratory service.

H. W. Clark, Inc., has opened an office at 11 Beacon St., Boston, Mass., for consulting work in sanitary engineering and sanitary chemistry. Mr. Clark, who was for many years director of the Lawrence Experiment Station of the Massachusetts Department of Public Health, has had a large and varied experience in this field.

S. I. Zack, for ten years in the engineering department of the Sanitary District of Chicago, has been engaged as engineer on sewage and industrial waste problems by the Filtration Equipment Corp., 350 Madison Ave., N. Y., a subsidiary of the American Cyanimid Co.

D. C. Fenner, for 14 years manager of the Public Works Department of the Mack-International Motor Truck Corp., has been made a vice-president of that corporation.

Harry W. McQuaid has joined the metallurgical staff of the Republic Steel Corp.

Harold W. Baker, former commissioner of Public Works of Rochester, N. Y., and later Director of Construction of the District of Columbia, has been made city manager of Rochester.

F. W. Young, formerly of Filtration Engineers, Inc., and more recently of The Pulp Filter Company, has joined the sales organization of Oliver United Filters, Inc., New York, Chicago, San Francisco & Toronto.

American Road Builders' Association:

The detailed program of the ARBA meeting to be held at Chicago, Ill. (the Stevens Hotel), on January 22-25, has not yet been completed in full. The general session on Monday, the opening day of the convention, will be addressed by Thomas H. MacDonald, chief of the Bureau of Public Roads; Charles M. Babcock, representing the American Association of State Highway Officials; and O. S. Warden, chairman of the Montana State Highway Commission and president of the American Association of State Highway Officials.

A railroad rate amounting to one and one-third the one-way fare for the round trip has been made. When purchasing tickets a certificate, not a receipt, should be obtained from the ticket agent. This certificate, when validated at Chicago, will permit the return ticket to be purchased at one-third the regular fare. Stop-overs will be permitted on the return trip.

The New York State Sewage Works Association will hold its sixth annual meeting at the Hotel McAlpin, New York City, Jan. 16, Following the annual business meeting, which begins in the forenoon, there will be six papers by A. J. Fischer, C. E. Keefer, Arthur S. Tuttle, Major G. H. Gleason, A. B. Holmstrom and Prof. Thorndike Saville. Afterward, there will be a trip to the sanitary engineering laboratories of N. Y. University; in the evening, the annual dinner with the Sanitary Engineering Division of the ASCE will be held at the McAlpin. On Wednesday, through the courtesy of the Municipal Sanitary Service Corp., a visit, by bus, will be made to the Rockville Center sewage treatment plant.

The American Public Health Association will hold its 63rd annual meeting at Pasadena, Calif., Sept. 3 to 6, 1934. Dr. J. D. Dunshee, health officer of Pasadena, is chairman of the local committee on arrangements.

Books and Booklets:

A paper presented by A. Peterson, chief engineer of the Pump Department of the De Laval Steam Turbine Co., Trenton N. J., before the American Water Works Association, has been reprinted by that company and is available for general distribution. Curves and tables of efficiencies are presented, and suggestions for possibilities of large annual savings to municipalities on pumping are made.

A paper by Wallace L. Howe on "The Cleaning of Porous Plates and Tubes in Sewage Disposal Plants" has been reprinted by the Norton Co., Worcester, Mass., manufacturers of porous plates and tubes, and is available for free distribution.

"The Rebuilding of Blighted Areas" has been issued by the Regional Plan Association, Inc., 400 Madison Avenue, N. Y. The price is $2.

"A Proposed System for the Analysis and Field Control of Fresh Concrete" has been issued as Bulletin 113, 64 pages, of the Iowa Engineering Experiment Station, Ames, Ia. W. M. Dunagan is author.

"Statistics of Motor Truck Operation in Ohio," by Robert Winfrey, has been issued as Bulletin 114 of the Iowa Engineering Experiment Station, Ames, Iowa. The data cover registrations, operation, total operating costs and tax information.

"Asphalt Block Construction." This is the fourth in the series of asphalt construction manuals issued by the Asphalt Institute, 801 Second Avenue, N. Y. 20 pp.; well illustrated and well written.

New Catalogs:

The Cletrac 80 Diesel is described fully, and power curves illustrated, in a new bulletin just issued by the Cleveland Tractor Co., Cleveland, O.

Toncan Iron Pipe, a product of the Republic Steel Corporation, Youngstown, O., is very fully described in an elaborate 64-page booklet made to fit A. I. A. file 29-B-8. Another booklet on the same subject "The Story of Toncan Iron Pipe" contains much interesting and valuable information.

Letters to the Editor

The Water Wheel

Dear Editor:—I am interested in the articles you published under the WATER WHEEL in December, and would very much appreciate a copy of the article No. 7—"Promiscuous Electric Grounding on Water Service Pipes and Mains," by N. S. Hill, Jr., C. G. Meyerherm and M. W. Cowles.

If you are unable to furnish me a copy of this article, please advise how I may obtain same.

City Engineer, Michigan.

Ed. Note: We were glad to send a complete copy of the article referred to, as is our general policy in such matters.

Pipe Specifications

Dear Editor:—I am expected to write specifications for some $12,000 of cast iron pipe for the city of ———. I had intended using AWWA specifications for Class B pipe, but find that this would greatly limit the number of pipe makers who could compete and would increase the cost. I want to get the best prices possible and still get satisfactory pipe. I thought you might put me right on this.

County Engineer, Kansas.

Ed. Note: We were glad to send complete information on this, suggesting such specifications as would, while securing good and satisfactory pipe, allow the pipe to be bought at the best price per foot.

Lost or Stolen

Dear Editor:—Recently you had three articles on "Retaining Wall Design." Some one has begged, borrowed or stolen my copies, and I am writing to ask if I may obtain reprints of these articles.

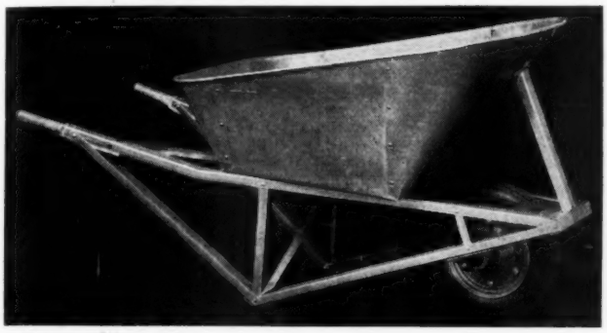
Office Engineer, Missouri.

Ed. Note: Only two of the articles have been published yet. The third will appear in an early issue. We were glad to send additional copies of the issues containing these articles.

Modernized Equipment

Wheelbarrow Modernized:

Sheet Aluminum Corporation, Jackson, Mich., claim to have made the first real development in wheelbarrows in 50 years. Their wheelbarrows are made of high strength aluminum alloy—HYB-LUM—in combination with bronze bearings, tubular axle, disc demountable wheels and pneumatic tire. The weight is reduced over 40 lbs. Pneumatic tires eliminate the necessity for planking or other runways. Loads of 40 lbs. more can be easily handled and the wheelbarrows will pay for themselves in from 30 to 60 days. The empty return trip being less fatiguing leaves more strength for the load.



Less labor—more work done—the modern wheelbarrow.

HYB-LUM wheelbarrows are made in 2 sizes, 4½ and 2½ cubic feet capacity. Write for full details.

Spray Outfit for Curing Concrete Roads:

A self-propelled power multiple spray machine for curing concrete with a bituminous compound has been developed by the Johnson-March Corporation, No. 29-28 Hunter Avenue, Long Island City, New York. The complete unit, including gasoline motor, transmission, pressure pump and warming device, is carried on a channel iron chassis, mounted on four flanged whee'ls that run on the steel side forms of a concrete road.

The wheels are adjustable on the shaft for either a ten or twelve foot slab width. Where the slab to be cured is adjacent to one already completed, the wheels on either side may be easily replaced with plain treads and moved outward in order to give a bearing on the finished concrete.

Eleven brass nozzles, of special design, are located at intervals around the radial spray bar, so that the fan of each spray will overlap 50 per cent. The warmed material is pumped to a manifold, from which an equidistant lead supplies each spray head. This method of distribution eliminates unequal material feed and difference in flow due to friction and assures a uniform coat over the entire slab with one application.

In order to overcome extreme variations in viscosity, due to the temperature range during the concreting season, the spray unit is equipped with a warming tank, so that the material is maintained at about 130 degrees.

The power is supplied by a 5 H.P. air cooled gasoline engine, with a regulator and hand starter. The transmission drives on all four wheels, and is connected with a clutch for forward and reverse travel. The gear pump, which supplies the material pressure, is connected to the motor with a separate clutch, so that it may be operated independently of the machine. Each machine is equipped with two leads for a single spray gun for spraying odd shaped slabs.

The rate of travel is approximately 1½ miles an hour, forward or reverse. The entire operation is controlled by one man who rides the machine. This multiple spray is designed to run anywhere that a finishing machine will, and to give complete coverage of the slab at one operation. The amount of material sprayed is regulated by the speed of the machine and the pump pressure.

A Modern Method of Curing Concrete Roads.

Two Important Pieces of New Equipment

Cletrac "80" Diesel:

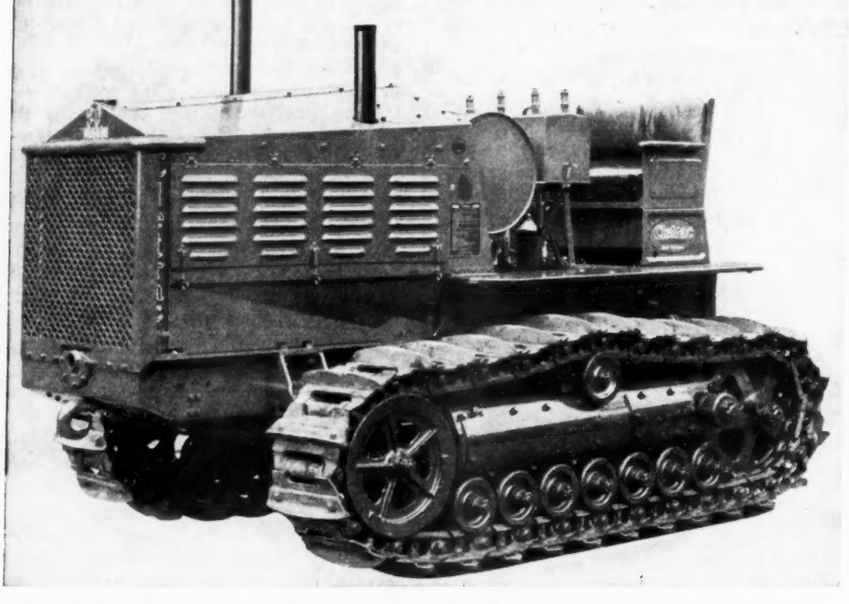
The Cleveland Tractor Company announces a Diesel crawler tractor in the 80 horsepower class, which develops 85 H.P. in second gear. Other than engine, the Cletrac Diesel has the same specifications as the gasoline powered Cletrac 80.

The heavy weight per horsepower of Diesel engines has been one of the chief objections which have retarded their use as power units for tractors. This objection has been largely overcome in the Cletrac Diesel.

Though development of satisfactory starting devices has been a problem that handicapped the use of the Diesel engines for mobile power units, starting the Cletrac 80 Diesel is as easy as starting the Cletrac 80 gasoline tractor, as electrical equipment of ample capacity is standard on the Cletrac Diesel. Another advantage of electrical equipment of this type is that it permits the installation of lights at a minimum expense.

Wherever possible, the features of the Cletrac 80 gasoline engine have been incorporated in the Diesel engine. For example, the underhung crankshaft and the "through" bolts which pass through the cylinder heads, block, crankcase and main bearing caps so that all vertical stresses are transferred from the cylinder heads directly to the crankcase, have been included as features in the Cletrac Diesel engine.

A Bosch fuel distributing pump and fuel pump are used. The fuel delivery tubes lead from the pump to the nozzles on the left side of the engine.



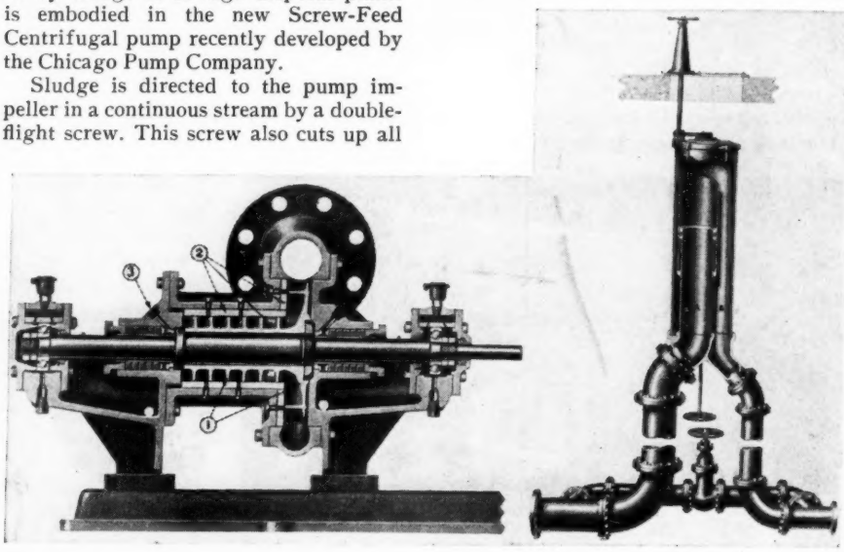
The Cletrac "80" Diesel overcomes many of the old objections to diesel tractors and saves up to 75% on fuel costs.

New Sludge Pump for Sewage Treatment Plants:

An entirely new idea for pumping heavy sludge in sewage disposal plants is embodied in the new Screw-Feed Centrifugal pump recently developed by the Chicago Pump Company.

Sludge is directed to the pump impeller in a continuous stream by a double-flight screw. This screw also cuts up all solids that would not otherwise pass through the pump. The cutting takes place between the edges of the screw and cutting edges in the screw housing. Any solid that has a tendency to clog the pump is instantly cut in two.

The pump operates at a constant speed and has a fixed capacity. The operator knows that his pump will deliver a fixed number of gallons per minute. He knows how much sludge can be safely pumped to his digester. He merely allows the pump to run for the required length of time. If he has a 50-gallon-per-minute capacity pump and 150 gallons of sludge to pump, he allows his pump to run three minutes. This screw-feed pump will not suck a hole through the sludge blanket because the screw acts as a regulator to the flow. In plants where the rate of incoming sewage is known, an electric timing device for determining the frequency and duration of pumping can be installed to give completely automatic operation. This method of pumping primary sludge intermittently or continuously at a constant speed has been proved to be better than attempting to pump sludge at varying speeds.



A new idea in sludge pumps—a screw feed and regulator that delivers a fixed amount

This pump is used with equal success in pumping sludge from the final settling tank. In this connection the Chicago Pump Company has developed a sludge flow regulator to give absolute control over the outflow of sludge from the final settling tank. Through the use of this, the pump can be operated continuously and the amount of sludge it handles can be varied.

The Screw-Feed Centrifugal pump is built in three types for various kinds of installations. They are: Horizontal, Vertical Open-Shaft and Vertical Enclosed-Shaft. The Horizontal Pump is installed in a dry pit lower than the level of the sewage in the settling tank, or in the basement of an adjoining or nearby building. The Vertical Open-Shaft Pump is installed in a dry pit with the motor above the floor level and the pump on the floor of the pit. The Vertical Enclosed-Shaft Pump is submerged in the sewage with the motor above the floor line.

Upon request the Chicago Pump Company, 2300 Wolfram Street, Chicago, will send copies of Bulletin 128 D1 which thoroughly describes and illustrates the Screw-Feed Centrifugal Pump and the Chicago Sludge Flow Regulator and shows methods of installation.

Need Special Information? Use this Readers Service

Snow Removal

344. "Control Winter Drifts"—A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Peoria, Ill. Illustrated in two colors.

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 400 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

Ferric Chloride

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Overs at Middletown, N. Y.; Marion, Ohio; Cleveland, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Jointing Materials

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Meters, Sewage and Water

405. Just issued. Every sanitary engineer should have a copy of this new 32 page booklet describing the applications, types and distinctive features of the new Bailey meters for sewage treatment and water supply. Sent promptly. Bailey Meter Co., 1027 Ivanhoe Road, Cleveland, Ohio.

Pipe Forms

407. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Index to Advertisements

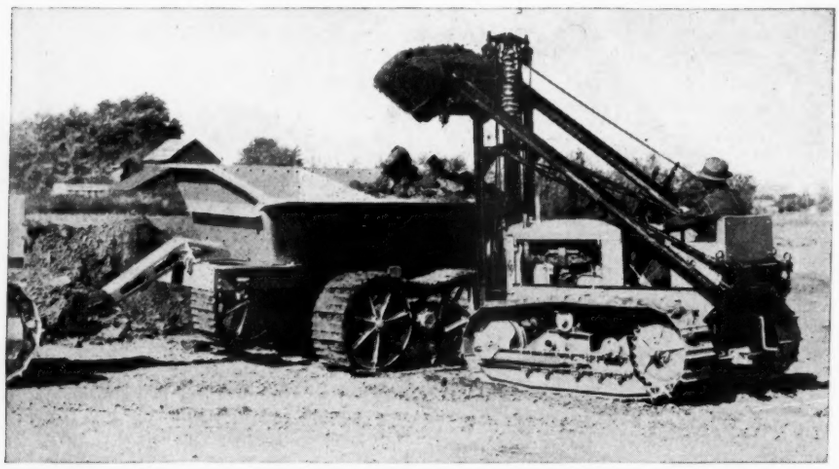
Engineering Equipment

A FRONT-END LOADER LOCATOR FOR PIPE LINES
NEON FLASHING HIGHWAY SIGNALS

Front End Loader:

In collaboration with Allis-Chalmers, the Frank G. Hough Company of Chicago, Illinois has developed this new front end shovel loader for the A-C Model "M" tractor.

There are many uses for the loader, both in the field and around factories. At a recent working test, this equipment opened a new gravel pit and loaded to trucks an average of 32 cubic yards an hour. The standard 1/3 yard bucket can be removed and a bulldozer blade installed, or a larger bucket can be used for handling snow and other light material. The unit is hydraulically controlled and is completely equipped with counter weights and rear starting crank. The drawbar is clear for use on any pulling work. Complete information and specifications may be obtained from either the Allis-Chalmers Manufacturing Company, Tractor Division, Milwaukee, Wisconsin, or the Frank G. Hough Company, 919 North Michigan Avenue, Chicago, Illinois.

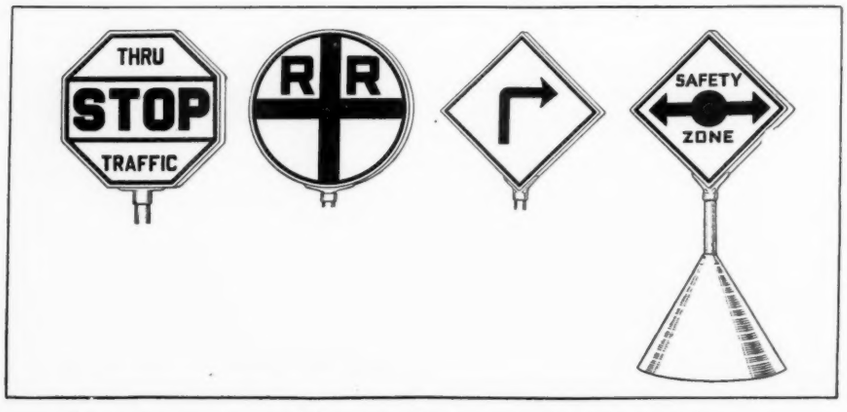


The Allis-Chalmers-Hough loader.

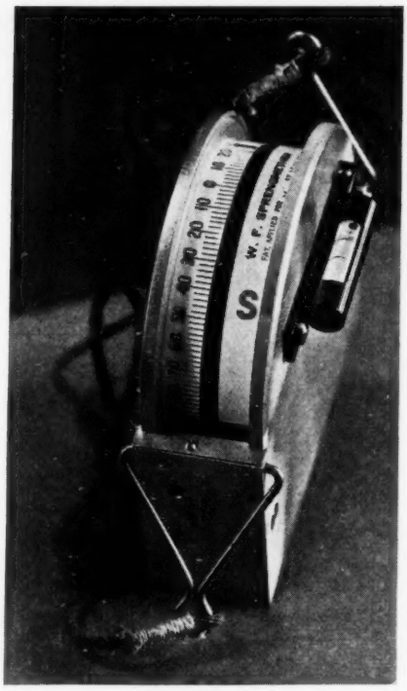
Neon Battery Operated Signals:

For night travel, estimated at 40% of the total, the usual painted caution and direction highway signs are unsatisfactory. The Lakewood Engineering Co., Columbus, O., have developed a "safety Neon flasher" which is readable at 350 to 500 feet, and which costs only 1 cent a day to operate. With shatterproof glass, these offer a durable, efficient and cheap signal. A battery well under the post is used for the Willard "low-discharge" battery. The battery is estimated to have a life of 6 to 10 years, and requires recharging at intervals of 6 to 15 months. A hinged base on the post gives easy accessibility.

Fuller information on these signals can be obtained from the manufacturer.



Here are pictured some of the types of highway signs made by the Lakewood Engineering Co.



The Sprengnether Compass.

For Locating Water Mains:

A magnetic dip compass, with unbreakable pyroxylin windows, has been put out by W. F. Sprengnether, 14 N. 9th St., St. Louis, Mo. This is designed to locate water and gas mains, valve outlets, stop boxes and ferrous ore deposits. It is stated to be extremely accurate and to be exceptionally convenient to use.